

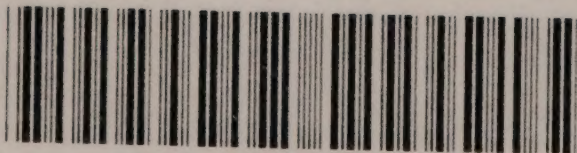
C. ix. 78.

EX LIBRIS



WELLCOME BUREAU OF SCIENTIFIC RESEARCH

LONDON



22102349106

T.6

Med

K21522

THE PROPERTY OF
THE WELLCOME BUREAU
OF SCIENTIFIC RESEARCH.

WELLCOME BUREAU OF SCIENTIFIC RESEARCH

A
MANUAL OF CONSERVANCY

A MANUAL OF CONSERVANCY

BY
JAHAR LAL DAS,
L.M.S. (Cal. Univ.)

MEMBER OF THE ROYAL SANITARY INSTITUTE ; HEALTH OFFICER TO THE
DISTRICT BOARD OF BURDWAN ; JOINT AUTHOR OF "A TREATISE ON
HYGIENE AND PUBLIC HEALTH", &c. ; FORMERLY TEACHER OF
HYGIENE IN THE TRAINING CLASS FOR SANITARY
INSPECTORS, BENGAL, AND HEALTH OFFICER
TO THE MANIKTALA MUNICIPALITY,
CALCUTTA

WITH AN INTRODUCTION BY
CHAS. A. BENTLEY,
M.B. (Edin.), D.P.H., D.T.M. & H. (Camb.)

SANITARY COMMISSIONER FOR BENGAL ; PROFESSOR OF HYGIENE IN THE
CALCUTTA MEDICAL COLLEGE AND EXAMINER IN HYGIENE TO THE
UNIVERSITY OF CALCUTTA AND STATE MEDICAL FACULTY,
BENGAL



CALCUTTA :

BUTTERWORTH & CO. (INDIA), LTD., 6, HASTINGS ST.

WINNIPEG :

SYDNEY :

BUTTERWORTH & Co. (Canada), Ltd.

BUTTERWORTH & Co. (Australia), Ltd.

LONDON :

BUTTERWORTH & CO., BELL YARD, TEMPLE BAR.

Medical Publishers.

1919

93310

*Printed by K. C. Neogi, Nababibhakar Press,
91/2, Machuabazar Street, Calcutta.*

21584463

WELLCOME INSTITUTE LIBRARY	
Coll.	weIMOmec
Call	
No.	WA

All Rights Reserved.

To
HIS EXCELLENCY THE RIGHT HON'BLE
LAWRENCE JOHN LUMLEY DUNDAS,
EARL OF RONALDSHAY G.C.I.E.,
GOVERNOR OF BENGAL,

TO WHOSE GENIUS, ENLIGHTENED ZEAL AND UNTIRING
ENERGY SO MUCH HAS BEEN DONE IN CONNECTION
WITH THE PROMOTION OF SANITATION IN THIS
COUNTRY, THESE PAGES ARE MOST
RESPECTFULLY INSCRIBED BY
THE AUTHOR

PREFACE

While engaged in training men for the positions of Sanitary Inspectors and Health Officers, the students have often expressed themselves as being in need of a practical guide to their course on Conservancy and this is the principal reason for my bringing out this little volume.

This work is intended primarily for the students undergoing training in the sanitary classes started recently in the different parts of India under the Sanitary Reorganization Scheme of 1912. It may also be profitably used by those engaged in conservancy work and who for want of a suitable guide are very often handicapped in their task of keeping the towns clean. It has been my chief endeavour to render the work of as much practical utility as possible.

The care and management of conservancy cattle constitutes one of the principal duties of a Sanitary Officer, and if these animals, which are very largely employed by Municipalities in India, are not properly looked after, fed and protected against the onslaught of infective diseases the whole system would sooner or later break down completely. Hence it is of the utmost importance that the Conservancy Officer should have some knowledge of managing and treating cattle in order to guard against a sudden collapse of the cleansing work, on the efficient performance of which depends much of the health and well-being of the residents of a town. Moreover, in the Mofussil or country districts a qualified Veterinary Surgeon is hardly to be had every time he is wanted, and it is often too costly for an outlying poor Municipality to maintain a properly equipped veterinary staff. Having all these points in view a special section (Part III) dealing with cattle management, etc., has been incorporated. Since Hookworm infection

is rather intimately related to defective conservancy a short chapter, dealing with its causation and prevention has been appended.

The prices of appliances, etc., given in the book are those that prevailed in the market before the great European War broke out. Since then there has been a considerable rise in prices of all sorts of materials, especially of those made of iron.

I take this opportunity to acknowledge my great obligation to Dr. Chas. A. Bentley, Sanitary Commissioner for Bengal, for his kindly writing out the introduction to the book and permitting me to reproduce the diagrams used for illustrating the chapter on Hookworm disease. I am also indebted to Messrs. Bird & Co., Managing Agents, Civil and Sanitary Engineering Co., Ltd., Calcutta, and to Messrs. Jas. Lumsden and Co., Managing Agents, Sanitary and Septic Ltd., of 15 Clive Row, Calcutta, for lending blocks for illustrating the book.

BURDWAN, }
July 15, 1919. }

J. L. DAS.

CONTENTS

	PAGES
INTRODUCTION	xv—xix
PART I.	
SCAVENGING	1-40
CHAPTER I. Preliminary Observations	3-12
Kinds of Refuse—Definition of the terms Scavenging and Conservancy—Refuse removal by Contract—Conservancy Staff—Qualifications and Duties of Conservancy Officer—Duties of Chaprassis or Mates and Carters—Stock Register—Sweepers—Strike of Sweepers.	
CHAPTER II. Removal of Refuse	13-26
Nature of Refuse—Sources of Refuse—Collection of Refuse—Dusbins—Street Sweeping—Refuse Carts—Refuse removal in Calcutta—Appliances for collecting and removing refuse—Estimation of carts and animals required—Labour Staff—Cost for removal of refuse.	
CHAPTER III. Disposal of Refuse	27-38
Principal Methods—Dumping—Made Soil—Tank Filling by street-rubbish—Precautions to be adopted—Advantages claimed for Dumping—Refuse disposal at Darjeeling—Incineration—Incinerators—Incineration in Colombo, Madras and Calcutta—Refuse disposal in Rural Areas.	
CHAPTER IV. Disposal of Carcasses	39-40
Collection of Carcasses—Carcass Carts—Private Carcasses—Disposal of Carcasses—System in Calcutta.	
PART II.	
CONSERVANCY	41-112
CHAPTER I. Introductory Remarks	43-45
Hand Removal or Dry System of Removal of Excreta—Difference between Latrines and Privies—General Hints.	

	PAGES
CHAPTER II. Privies and Latrines	46-64
Reasons why these should be installed—Principles of their Construction—Privies—Selection of Site—Parts of a privy and their Construction—Privy pan or nightsoil receptacle—Cesspit—Privy for storied houses—Privy Accommodation—Commode—Well or pit privy—Public Latrine—Various types—Sites and Distribution—Kinds of Latrines—Fixed or Permanent latrines—Temporary or Movable latrines—Urinals.	
CHAPTER III. Collection of Nightsoil	65-67
Existing System—Number and Distribution of Methers—Objection to Night Service—Duties of Methers.	
CHAPTER IV. Removal of Nightsoil	68-74
Estimation of the Quantity of solid and liquid filth requiring removal—Nightsoil Removal—Pail Depôts—Receptacle System of Removal of Nightsoil—Removal of filth by Railways.	
CHAPTER V. Conservancy Appliances	75-78
Pails—Nightsoil Carts.	
CHAPTER VI. Disposal of Nightsoil	79-91
Methods—Government of India's Observations—Trenching of Nightsoil—Trenching Ground—Circular for the Management of Trenching Grounds in Bengal—Latest Experiments on Nightsoil Trenching—General Hints for Managing Trenching Grounds—The Thornhill System of Trenching Nightsoil—Pitting System—The Nasik System—Incineration of Nightsoil—Merits and Demerits of the Hand Removal System—Disposal into Sea.	
CHAPTER VII. Biological Method of Disposal of Nightsoil	92-103
Disposal by Septic Tanks—Dumping Septic Tank—Septic Tank—Advantages claimed for this system—Aqua Privy—Different types—Secondary Vessels—Multiple Aqua Privy.	
CHAPTER VIII. Disposal of Sullage	104-110
Composition of Sullage—Sullage removal in Municipal towns—Removal by <i>kutchha</i> or non-masonry drains, <i>kutchha-pucca</i> drains and <i>pucca</i> or masonry drains—Disposal of Sullage—Bacteriological or Sullage Filter—Disposal of Sullage in Rural Areas.	

	PAGES
CHAPTER IX. Conservancy Arrangements in Fairs and Melas	111-112
Organization of Staff—Latrines—Arrangements for dealing with rubbish and dead animals—Urinals.	

PART III.

CATTLE MANAGEMENT	113-160
CHAPTER I. Preliminary Remarks	115-124
Suitability of Animals employed for Conservancy Work—Shortcomings of Drivers— <i>Gowkhana</i> or Cattle-yard—Duties of the <i>Gowkhana</i> Superintendent—Construction of <i>Gowkhana</i> or Cattleyard—Cleansing of <i>Gowkhana</i> —Healthy Animals—Points in a Good Bull—Aging an Animal—Harnessing—Shoeing of Cattle—Preparation of the Foot for shoeing—Shoeing of Horses.	
CHAPTER II. Feeding of Animals	125-133
Principles of feeding—Hours for feeding animals—Different kinds of food—Grasses—Hay or dry grass—Straw—Concentrated foods—Oil cakes—Roots—Feeding of Cattle—Sick Diets.	
CHAPTER III. Rest and Work	134
General Hints.	
CHAPTER IV. Minor Ailments	135-143
Neck or Yoke Galls—Broken Horns—Displacement of Patella—Dum Dum Sore—Sprains—Wounds—Abscesses—Tympanitis or Hoven—Choking—Diarrhœa—Sunstroke.	
CHAPTER V. Prevention of Infective Diseases	144-149
Means of Prevention—Cleansing and Disinfection of Stalls—Common Disinfectants—Disposal of infective carcasses.	
CHAPTER VI. Infective Diseases of Cattle	150-159
Rinderpest—Foot-and-mouth Disease—Anthrax—Hæmorrhagic Septicæmia—Black Quarter.	

PART IV.

APPENDICES	161-182
Appendix A.—Sections of the Bengal Municipal Act dealing with sewage, offensive matter, rubbish, privies and drains	163-168

	PAGES
Appendix B. —Model bye-laws relating to Conservancy for Municipalities in Bengal	169-171
Appendix C. —Sections of the Puri Lodging House Act relating to Conservancy	171-172
Appendix D. Sections of model byelaws under the Bengal Lodging House Act relating to Conservancy ...	172-173
Appendix E. —Modern rules relating to Privies and Urinals framed by the Government of Bengal ...	173-175
Appendix F. —Sections of the Bengal Local Self-Government Act relating to Conservancy	176-177
Appendix G. —Hookworm Disease or Ankylostomiasis ...	178-182
INDEX...	183-189

LIST OF ILLUSTRATIONS

FIG.	PAGE
1. Dustbin fitted with frame at top and bottom	17
2. Open Refuse Cart	18
3. Covered Refuse Cart	19
4. Double wheel or Handbarrow	20
5. Tank Filling by Compartments	29
6. An Ordinary Small Incinerator	34
7. 20th Century Latrine Seat	50
8 and 9. Galvanised iron Antisplash Pails	51
10 and 11. Galvanised iron Liquid Receptacles	52
12. Tower of Privies	54
13 and 14. Commodes	55
15. Donaldson's Patent Latrine Seat (No. 4 Type)... ..	57
16. 17 and 18. Donaldson's Patent 4-Seated Latrine	58
19. Patent Portable Latrine (dismantled for storage or transport)	60
20. Patent Portable Latrine (Inside view)	61
21. Donaldson's No. 1 Type Glazed stoneware Urinal seat	62
22. Donaldson's No. 2 Type Glazed stoneware Urinal seat	62
23. Urinal with Donaldson's No. 2 Glazed stoneware seats and Galvanised iron sprinkling pipes for Nitrifying Bed or Tank	62
24. Donaldson's Patent Urinal seat fitted with No. 2 Type Seat	63
25. Section of Donaldson's Patent Urinal fitted with No. 2 Type Seat... ..	64
26. Receptacle Cart	73
27. Galvanised-iron Nightsoil Receptacle	75
28. Nightsoil and Urine Cart fitted with iron wheels	76
29. Revolving Body Nightsoil cart	77
30 and 31. Septic Tank Latrine	94
32. Cross Section of a Septic Tank	96
33 and 34. Section and Plan of Aqua Privy	98
35. Section of Multiple Aqua Privy	100
36. Galvanised stoneware V-shaped Surface Drain Pipe	107

FIG.		PAGE
37.	Galvanised stoneware Half-round or Surface Drain Pipe ...	107
38.	Horse with names of parts	138
39.	Male and Female Hookworms	179
40. 41 and 42.	Diagrams showing mode of infection by hook- worm larva	179
43.	Diagram of a foot showing ground itch.	180
44.	An Indian boy suffering from hookworm disease com- plicated with malaria	181

INTRODUCTION

An important paper by the late Surgeon-General Sir Pardey Lukis entitled "The Sanitary Awakening of India" which appeared in "Science Progress" for October 1913 contained the following statement: "On all sides there is evidence that the more enlightened minds in India have awakened to the importance of sanitation and the movement in its favour is steadily gaining ground. Both in the Council Chambers and in the columns of the Indian Press, constant demands are made for the three great essentials—pure water, pure food and pure air." In common with the rest of India, Bengal has experienced the sanitary awakening alluded to in the above quotation; and in no part of the country has the demand for sanitary improvement been more clear and more insistent than in this province. People of all classes are now eager to learn how to avoid disease, and this has led to an increasing demand for education in respect to the principles of Hygiene. Coincidentally with this awakening to sanitary defects and the demand for their remedy, there has also come about an awakening to political and civic consciousness in all respects comparable to the phenomena which not so many decades ago occurred in Great Britain, when simultaneously with a movement for Parliamentary reform and improved Local Self-Government came a recognition of civic responsibility in regard to the Public Health and a demand for corporate action to ameliorate the sanitary conditions under which the masses of the people up to that time had been compelled to live.

Some idea of the extraordinary changes that have been brought about in Great Britain within the last 80 years, may

be gathered from a reference to old sanitary reports. In 1838, a Government Commissioner reported as follows about the slums of Glasgow :—

“The *wynds* consist of long lanes, so narrow that a cart could with difficulty pass along them ; out of these open the *closes* which are courts about fifteen or twenty feet square, round which the houses mostly of three storeys high are built ; the centre of the court is the dung-hill, which, probably is the most lucrative part of the estate to the laird in most instances and which it would consequently be esteemed an invasion of the rights of property to remove In the lower lodging houses, ten, twelve and sometimes twenty persons of both sexes and all ages, sleep promiscuously on the floor in different degrees of nakedness. These places are generally as regards dirt, damp and decay, such as no person of common humanity would stable his horse in”.

Two years later Dr. Neil Arnott reporting on the condition of Glasgow to the Poor Law Commissioners observed :—

“We entered a dirty low passage like a house door, which led from the street through the first house to a square court immediately behind, which court, with the exception of a narrow path around it leading to another long passage through a second house, was occupied entirely as a dung-receptacle of the most disgusting kind. Beyond this court the second passage led to a second square court, occupied in the same way by its dunghill ; and from this court there was yet a third passage leading to a third court and third dunghill. There were no privies or drains there, and dung-heaps received all filth which the swarm of wretched inhabitants could give ; and

we learned that a considerable part of the rent of the houses was paid by the produce of the dung-heaps. Thus worse off than wild animals, many of which withdraw to a distance and conceal their ordure, the dwellers in these courts had converted their shame into a kind of money by which their lodging was to be paid."

Nine years later Dr. Sutherland, in reporting on the measures adopted in Glasgow for the relief of cholera said :—

"The interior of the houses is in perfect keeping with their exterior. The approaches are generally in a state of filthiness beyond belief. The common stairs and passages are often the receptacles of the most disgusting nuisances. The houses themselves are dark, and without the means of ventilation. The walls are delapidated and filthy, and in many cases ruinous. There are no domestic conveniences, even in the loftiest tenements, where they are most needed, except a kind of wooden sink placed outside some stair window and communicating by a square wooden pipe with the surface of the close or court beneath. Down this contrivance, where it does exist, is poured the entire filth of the household or flat to which it belongs, and the solid refuse not unfrequently takes the same direction, till the tube becomes obstructed."

The passages quoted above describe an appalling condition of things existing in Glasgow within the memory of living men. At that time sanitation was unknown, there were no Sanitary Inspectors anywhere and in the whole of Great Britain only two Medical Officers of Health, the first of these having been appointed in 1847 by the City of Liverpool and the second by the Corporation of the City of London in 1848. In the latter year the first Public Health Act for

England and Wales was passed establishing a General Board of Health for the country. But little real progress in sanitation was made until 1872 when the passing of a new Public Health Act made it compulsory upon the fifteen hundred urban and rural sanitary authorities in England and Wales to appoint both Medical Officers of Health and Sanitary Inspectors. From that time forward progress was rapid, and places which had previously been foul and pestilential speedily became converted into comparatively salubrious areas.

As an illustration of the remarkable change accomplished in less than 50 years reference may once more be made to the case of Glasgow, which in 1896 was referred to by Shaw in his *History of Municipal Government* as a model of sanitary administration where "considerations of the public health have been predominant in determining the most important lines of action entered upon within the last quarter of a century."

How has the change from the appalling conditions prevalent 50 years earlier been effected? By efficient organisation and the practical application of proper methods of conservancy and other sanitary measures. When Shaw wrote his book the Glasgow Health Department was employing a staff of 150 Sanitary Inspectors under an efficient health officer. As a direct result of the effective measures of conservancy adopted in the city, cholera and typhus fever have been entirely abolished and enteric fever, diarrhoea of infants, dysentery and other filth diseases have been brought within control.

In India the sanitary reformer is often inclined to be discouraged by the immensity of the task before him. On the one hand there is the ignorance and apathy of the population to be overcome and on the other sanitary organisation is still largely defective and the supply of trained sanitary officers are too few.

But attempts are now being made to remedy these defi-

ciencies and every year sees an increasing number of candidates seeking training in practical methods of sanitation and disease prevention. Dr. Jahar Lal Das's Manual of Conservancy has been specially written for this class of students and it will meet their wants in excellent manner.

But information in regard to conservancy should not be confined to sanitary officers only and I can heartily recommend this little volume to all those interested in sanitary reform.

CALCUTTA,
The 8th July, 1919.

CHAS. A. BENTLEY,
M.B., D.P.H., D.T.M. & H.,
Sanitary Commissioner, Bengal.

PART I
SCAVENGING

A MANUAL OF CONSERVANCY

CHAPTER I

PRELIMINARY OBSERVATIONS.

The health of the residents of a town depends very largely on the promptness and completeness with which all rubbish and excrementitious matters are removed from the house and its neighbourhood. In some European towns the removal of refuse is effected once or twice a week but the necessity for the prompt removal of filth of this nature is very great in a warm country like India where the climatic conditions—the heat and the moisture—favour its rapid decomposition. Damp and fermenting heaps of rubbish tend to pollute the air and favour the breeding of flies which are now well known as carriers of diseases like cholera, enteric fever, dysentery etc., and are largely responsible for the heavy mortality among infants ; they may also harbour rats which find ample food in them. A plague of flies in a town always points to defective conservancy arrangements, while a large reduction in their number is by no means an impossible task.

The term *refuse* is applied to all solid waste materials not carried by sewers, such as ashes, rubbish, garbage, street sweepings, manure etc. Where arrangements for removal of refuse are unsatisfactory clothes are fouled by street dirt which is carried into houses in several ways and has been shown to infect food and cause disease. There is

no more potent source of illness in crowded areas than the accumulation of decaying organic matter with which is accompanied flies and other life-destroying insects.

The waste products requiring removal are the *household* and the *trade refuse*, the *street rubbish* and the *latrine waste*, the last one consisting of human faeces and urine. The house-hold refuse is again of two kinds, viz., the solid and the liquid, the latter comprising waste water from the kitchen and slop water containing urine, drainage from cow houses, stables etc. The liquid waste of a town is generally known under the name of *Sullage*.

The collection, removal and disposal of dry refuse or dust—as solid matters are also called by some—constitute an important part of municipal work and are usually known under the name of *Scavenging System*, while that of the latrine waste as the *Conservancy System*, but speaking generally no distinction is ordinarily drawn between these two systems which are popularly known under the latter name. All conservancy work entails the employment of a large labour staff, vehicular plant, animals (horses and cattle) and other sanitary appliances. The conservancy work is either carried out by the Municipality itself or executed by contract and it has been found that refuse removal on the contract system has not generally proved successful. The work of the contractors is often below the standard with the result that serious nuisance and danger to public health occur. Moreover the contractors prove troublesome in various ways, they usually buy off the Jamadars or the headmen of the sweepers by loans and other means and very often succeed in setting up a strike among the sweepers when they find they are going to be replaced.

All conservancy work should be performed by a special staff employed by the Municipal Commissioners, and if necessary, the Government should be approached for the

grant of an aid instead of entrusting the cleansing operations to a cheap contractor.

All refuse must be collected daily and conveyed in suitable carts provided with covers or lids. In big towns railway wag-gons and tramway trucks are used for carrying refuse. Thus for example in Calcutta all street rubbish is removed by railways and in Amritsar by tramway trucks for final disposal. In Bombay and other big towns motor vehicles are also used for removing rubbish. In Paris, New York and other places electrically propelled vehicles having low bodies are employed.

In Municipalities where the amount of work is great it has always been found economical to maintain a workshop or *mistrikhana* for the repair, and, if possible, for the construction as well of vehicles and other appliances. But this should always be properly organised. Municipalities not in a position to maintain a workshop would do well to keep in stock the duplicates of all the working parts of a cart to provide against a sudden breakdown, when they can be fixed without any difficulty by unskilled labour.

Refuse of every description should be daily and completely removed once early in the morning, and, if possible, again in the afternoon, as is done in big cities like Calcutta, Bombay etc. There should always be a sufficient stock of sanitary appliances to meet the requirements of any sudden demand, as during an outbreak of epidemic diseases, or for fairs, festivals etc. Things that have become old and useless, or have gone beyond the stage of repair, should not be thrown away but stored and periodically sold by public auction, which should be previously announced by judicious advertisements throughout the Municipality to attract purchasers.

The *unit* of conservancy administration is the block or circle which is ordinarily placed in charge of a chaprassi, mate or peon, who is held responsible for the proper carrying out

of the cleansing operations. Big towns are usually divided into districts and a responsible officer or overseer is placed in charge of each section which is again subdivided into several smaller areas or blocks for easy working and efficient supervision. The Sanitary or Conservancy Inspector should always keep in his office a *Conservancy Map* of the town showing the number of blocks, the position of the cattle yards (or gow-khanas), public latrines, dustbins, pail or nightsoil transfer depôts, trenching grounds, dumping sites etc. A list showing the number of sweepers, methers, carts etc., allotted to each block should be hung up in the office for ready reference. A list of all privies, cesspits, roads and drains should also be kept.

To properly regulate the work of the conservancy department it is customary to divide the staff under the following principal heads :—

I. Coolies ...	(a) Road cleansing	} Scavenging
	(b) Drainage	
	(c) <i>Bustee</i> cleansing	
II. Refuse Cart drivers		
III. Methers, Bhangis or Halalkhores		} Conservancy
IV. Night-soil and Sullage carters		
V. Trenching ground diggers or coolies or Bailders		

In addition to these Municipalities also employ scavengers or *domes* whose work consists in removing the carcasses of animals from the roads, as no other people will touch or remove them. Where a large number of *bustees* exist special coolies for attending to their cleanliness are employed. (A *Bustee* means an area occupied by a collection of huts or buildings having no material portion above the plinth level made of masonry). For removing refuse from cowhouses or cattlesheds, where these exist in any number, a separate staff (known in Bengal as the *goala bustee* staff) is also employed.

Such refuse is classed as a trade one as the *goalas* or milkmen and the carters keep animals for profit or trade, and therefore a special fee for its removal is charged. The scale of fee per head of cattle (cow or bullock) is annas four per month and annas eight for each buffalo in the Municipalities adjoining Calcutta.

Qualifications of a good Conservancy Officer.—According to Sterndale a conservancy officer will never be a popular character if he does his duty conscientiously, it is impossible that he should be, nor is it necessary. He must be a man with tact and good temper, gentle but firm, not to be turned aside from his duty by promises, threats or abuse ; but not to be given to retorts, vituperation, hard language, or threats of reprisals. He should be perfectly honest, methodical and observant, taking note of every little defect and remedying it at once. He should never get into the habit of overlooking trifles, however insignificant they may be, but should take a real interest in his work and in keeping his ward or beat quite clean and tidy for he is responsible for the health and comfort of the people residing therein.

He must look to and do everything personally and not be always *going* to do it. He should be quite prompt in his work and never put off till to-morrow what can be done to-day. He should possess capacity to control his subordinates properly and for organization as well, and on no account overlook any misconduct, neglect or shortcomings on the part of his staff. He must, in short, be honest, punctual, dutiful, fearless and impartial.

Duties of a Conservancy Officer.—The conservancy work constitutes one of the principal duties of the Sanitary Inspector. He should take the early muster of the sweepers and carters and distribute the work among them ; look to the cleansing of the public roads, lanes, bustees, drains and their outfalls, as well as of the public latrines, privies and cesspits.

inspect daily the trenching grounds, sullage filters (if any), gowkhanas (cattle yards) and the Municipal animals and vehicles. He should take prompt repressive measures when any disease of an infectious nature breaks out among the conservancy animals. He must maintain discipline among the sweeper staff and personally investigate all the grievances of the coolies, as well as any report made against anyone of them by peons or jamadars in charge, as the latter not infrequently tease the sweepers for money or commission of some sort. Moreover all monthly cooly payments should be made in his presence to prevent any blackmailing. He should also arrange for the removal of carcasses and filth from the roads and streets and check the work of the staff under him. He must keep a diary of his daily work and submit it to the head of the department for information and also to receive instructions for his guidance.

Muster.—The conservancy staff should be mustered early in the morning and then the sweepers despatched to their respective beats at once.

In Calcutta the conservancy staff, which includes road sweepers, drain coolies, methers or bhangis, domes, carters and street watering coolies, are mustered at 5 and 5-30 A.M. in summer and winter respectively. If there be a separate man for taking the muster the inspecting officer should check the roll every now and then to satisfy himself that the number of coolies actually working tallies with those marked present in the roll.

Duties of the Chaprassies.—The chaprassi, mate or peon is the headman of the sweepers (road cleansing and drainage coolies), wheelbarrow men and rubbish carters, while the Jamadar is of the methers and methranis (female bhangis) night-soil carters and trenching ground coolies. The peons should look after the work of the men under him and report any irregularity, slackness or negligence on their part to the

Inspector. He must attend in the morning at the time when the muster is taken and remain in his section or beat all the working hours in the morning and note everything in a pocket book. He should also attend the office in the afternoon to submit his reports to his chief and to receive instructions as well.

The sweepers are usually wanting in their sense of duty and will not work properly if there is any lack of supervision. Moreover, they rarely miss an opportunity to take up private work during their hours of duty if they find that there is hardly any one to check them. The Inspecting officer should not lightly pass over the absence of the chaprassi from his beat during the working hours of the sweepers.

The carters or drivers as a class are in no way superior to the sweepers and their duties may be summarised as follows :—

Each carter must groom, water and feed his own animal. He must cut chaff whenever required, clean and grease his cart wheels. He must keep his cart clean by washing it regularly, follow the prescribed route and obey the rules of the road, carry all necessary implements and be held responsible for any loss or injury thereto. He must immediately after the muster drive to his block or beat, which he must clean properly. A close watch should always be kept over them as they very often avail themselves of any opportunity of selling or dropping rubbish indiscriminately, thus disseminating foci for breeding flies and diseases. Moreover any unnecessary delay in going to or returning from the dumping sites should be checked by admonition or fine.

For efficient working each of the various divisions of the sweeper staff should be placed under separate chaprassis. At every place for disposal of refuse, be it a dumping site or an incinerator, it is desirable to put a man or time-keeper to keep an account as to the number of trips each cart makes and also of the amount of rubbish taken there for disposal. He

should enter daily in a book or register the date, number and capacity of the cart, the number of the circle, the name of the carter and the time of his arrival at the dépôt.

Every conservancy officer must keep a stock register, a register of the establishment, *i. e.* of sweepers etc., and an admission book in which the following particulars concerning the employees should be entered—

Name.....

Father's name.....

Age.....

Caste.....

Country address.....

Name of village.....

Thana or Police station.....

District.....

Present address.....

Date of appointment.....

Date of discharge.....

Remarks.....

As these people very often give false names and addresses it is always better to take their finger impressions in the admission register. If this is done they generally do not venture to run away as they are afraid of being easily arrested and punished.

An account of the cost and feed of the live stock, plant and their repairs and contingencies should always be kept. In enlisting sweepers one should see that they are quite healthy and active and not too old or too young. Persons suffering from contagious skin diseases should not be allowed to work as carters as they are very likely to infect the animals.

The work of the cleansing department is performed by the low caste people and consequently depends entirely on the manner in which they work. They are clannish, very difficult to manage and will absent themselves from work on the slightest pretext, such as a shower of rain early in the morning or a marriage among their friends, etc. Moreover they are of a truant nature. It is customary to withhold half a month's pay, so that they are paid after the middle of each succeeding month, to enable the Municipality to make good any loss in case of their leaving work suddenly without returning the baskets, *kodalis* (spades) or other implements.

The sweepers, again, are apt to strike work without sufficient cause or notice. They have a good deal of unity among themselves and follow their headman or ring-leader blindly. They require therefore to be dealt with firmly but tactfully, as they are likely to abuse any treatment of a gentle or kind nature. The secret of extracting the last ounce of work out of them is to win their ring-leaders over, and, in the case of the methers to take their womenfolk (*i. e.* the methranis) into service. Experience shows that this procedure ensures good attendance and whole-hearted work.

The Local Self Government (Municipal) Acts give ample powers to deal with any sweeper absenting himself from work without any previous notice or by going on strike. Section 188 of the Bengal Municipal Act (Act III of 1884 B. C.) says that "no mether or any other servant of the Commissioners employed to remove or deal with sewage or offensive matter

or rubbish shall withdraw from his duties without the permission of the Commissioners, unless he has given notice in writing not less than one month previously of his intentions so to withdraw. Any mether or any other such person who withdraws from his duties without giving such notice as aforesaid shall be liable to rigorous imprisonment for a term not exceeding one month and shall forfeit all salary which may be due to him."

In case of a strike persuasive means, even by granting concessions, should first be tried, and if these fail the prosecution of the ringleaders usually brings things down to their normal state. The ringleaders or those who help to foment troubles should, if not prosecuted, be dealt with departmentally: either fined, degraded or dismissed. It is a good plan to import a new lot from outside, but there is also a probability of these men being won over by the strikers who are their castemen, so it is absolutely necessary that a close watch, to prevent them from mixing with the old gang, should be exercised over these newcomers for sometime after their importation. The consequences of a strike are always very grave and the municipal officers would do well to put up with almost anything rather than foment a strike.

The conservancy department should not only be thoroughly organised but properly supervised. The efficient working of the conservancy department means the reduction in disease and death-rate, increased longevity and capacity for work, and also increased comfort for the residents of the town.

CHAPTER II

REMOVAL OF REFUSE

The length of time allowed for refuse to remain accumulated near a dwelling is important, for the conditions prevailing in a warm country like India do not in any way resemble those of Europe. First of all the meteorological conditions are quite different : the rainfall in India is not distributed evenly throughout the year ; it is limited only to a few months when the showers are invariably very heavy, resulting usually in sudden flooding. Again the high temperature favours rapid decomposition of all sorts of refuse. Next the habits of the people themselves differ widely from those of the Europeans. The Indians are mostly vegetarians and their practice of throwing refuse in the streets at all hours of the day, coupled with their prejudices, make the work of keeping a town clean extremely difficult.

The quality and the quantity of refuse vary with the different seasons of the year, according to the size of the community and the system of disposal adopted ; a big town on a wet day will perhaps produce an enormously larger quantity of sloppy street sweepings than on a dry one. In manufacturing towns or in municipalities having a large number of mills and factories, the quantity of rubbish varies with the nature of the industry and the fluctuation of the output of such industries.

Decomposing vegetable refuse yields a liquid which is very foul and fermenting, while fragments of animal food putrefy and furnish a product allied to that from faeces. Again the quality of refuse differs enormously in different districts ; for instance the house refuse in the mining districts,

such as Asansol and Jherria, is rich in calorific value, whereas in country districts remote from mining areas the refuse usually lacks in value as a combustible material.

Sources of Refuse.—The principal sources of refuse are the occupied houses, places of business or trade and the streets.

Refuse from inhabited houses, or *household refuse* as it is called, is usually solid and composed ordinarily of ashes, dust, remains of vegetables and fruits, broken pots, waste papers, fish offal, rags, thatch, dung etc., while the *trade refuse* consists chiefly of waste materials from stables, cattle-sheds, mills, factories, hotels, markets etc. *Street refuse* consists of all such substances as are thrown in the streets together with road scrapings, animal droppings, dry leaves from trees, silt from drains etc. It is a common practice with the people of this country to throw human excreta (faeces) wrapped up in pieces of paper or rag on the street with the idea that the sweeper or *dhangar*, who is not a mether, would pick it up.

Collection of Refuse.—Refuse is collected from all houses whether infected with disease or not. All refuse should therefore be treated as infected. In order to collect and remove refuse it is incumbent on every municipality that it should maintain an adequate staff of sweepers, vehicular plant etc. The practice of throwing refuse from the windows and roofs at all hours of the day into the streets should be rigorously discouraged, and all local enactments relating to municipalities have power to prescribe hours within which all refuse must be deposited in special receptacles called dustbins. These by-laws should be strictly enforced for the general comfort and health of the public. So long as this is not done all refuse accumulating in any house should be kept in a heap on the road in front of the premises until the conservancy service is completed. By-laws should also be framed prohibiting the accumula-

tion of filth on private premises. The collection of refuse is ordinarily done once every morning, but in big towns it is done twice or even thrice a day. All droppings of animals on the roads should be removed as often as possible.

House refuse is removed free by municipalities. In big towns like Calcutta special arrangements are made for the removal of kitchen and other refuse during any festive occasion, such as marriage or any other entertainment, on a previous application being made to the municipality, which charges eight annas for each cart load taken away.

Dustbins.—To facilitate the collection of refuse, municipalities usually place dustbins (see fig. 1) on the sides of roads and streets for the deposit of all waste materials till they are removed by scavenging carts and wheelbarrows. The dustbins are usually made of galvanized, corrugated iron and are either round or rectangular in shape, open at both ends which are fitted with angle-iron frames and provided with a pair of handles for lifting up easily. These should be placed on an impervious platform raised a little (2 or 3 inches) above the road surface and at a reasonable distance (at least 6 feet) from any dwelling room. These should be judiciously distributed,—the density of the population and the class and habits of the people are the factors influencing their distribution. Bins should also be placed in front of bazars, *hauts*, bustees, mills, stables, hotels, factories, slaughter houses etc., or in fact near any place where the quantity of refuse is likely to be large. It is advisable to distribute freely a large number of smaller dustbins than a few larger ones placed at long intervals. The bins should have their numbers painted on them and the conservancy officer should always keep a list of them, noting in it their position of allotment and also see that they are not shifted without a previous reference to him.

The dustbins should be gently lifted and not thrown about with violence as is generally the practice with the sweepers.

Although all refuse is considered to be infected yet no means are ever employed to clean or disinfect the bins, their cleansing being left entirely to the rains. The bins should be replaced properly after their contents have been shovelled into the carts. They should be tarred periodically as this prevents rusting. The price of a dustbin varies according to its size, but an ordinary one 3 feet high and 30 inches in diameter would cost about Rs. 12 and with due care should last about a couple of years or more.

Street Sweeping.—Immediately after they muster the sweepers should commence sweeping the roads : the larger and more important thoroughfares are to be attended to first. All sweepings thus collected should either be deposited in the dustbins or so heaped at the sides of the road as not to obstruct the traffic in any way. In dry weather it is better to previously lightly water the roads to lay down the dust before commencing to clean them. Paved streets in big towns are also swept by mechanical sweeping machines. Such a machine is very easily operated and arranged for animal traction and usually sweeps a course of about 6' 6" broad. The brush is made of best selected brass and about 7 feet long and 21 inches in diameter. All these road-sweepers are strongly made and save a vast amount of labour. The scavenging carts should follow the sweepers and the carters remove all the collected heaps of rubbish to the carts, which, when full, finally wind slowly their way to the dumping ground, or else, as in the case of big towns, to the refuse platforms or depots to have their contents transferred to railway wagons as is done in Calcutta, or to tramway trucks as in Amritsar. The carters should always move along with their carts and be provided with the necessary implements, such as baskets, *kodalīs* etc., for easily picking up refuse. The carts should be provided with covers or lids to prevent the lighter particles of refuse from being blown about. In narrow lanes and passages which are not wide enough to

admit carts, wheelbarrows or hand-carts should be employed to remove refuse. In the narrow lanes of up-country towns donkeys and mules are also employed, the refuse being removed in bags or baskets hanging from either side of their backs. Motor vans are used in Bombay and in many big towns in Europe for the speedy removal of rubbish, but the most popular vehicle in this country is the refuse cart drawn by a single bullock.

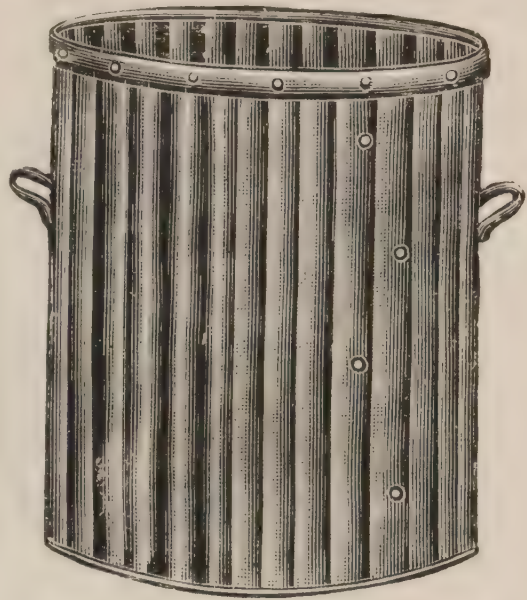


Fig. 1. Galvanised Corrugated Dust Bin, fitted with frame at top and bottom. (Civil and Sanitary Engineering Co., Calcutta).

The roads should be swept daily as street cleansing is a very important factor in maintaining good health. Road scrapers are used in wet weather in advanced towns to remove all sticky mud from the surface of the streets. The machines, as used in Calcutta, have a diagonal scraper composed of a number of teeth which descend on the road when the driver places his foot on a lever. The teeth are fitted with steel springs and adjust themselves to uneven surfaces and scrape nearly six feet clear. The scrapers are constructed entirely of iron and steel, and are compact, light of draught, well balanced and of very simple design. In some backward towns in India the roads are not swept but only scraped by the sweepers periodically during the rains.

Refuse Carts.—Refuse carts should always be simple in construction, light and strong. The body should either be made of seasoned wood or galvanised iron, revolve on the axles which must be quite strong and made of steel 2" square and 6'3" in length, and be provided with a

detachable tail-board. The wheels should better be made of iron, as wood wheels very often shrink and their spokes become shaky during the hot weather. The shafts and yoke should be quite smooth. The cost of a galvanised iron cart,

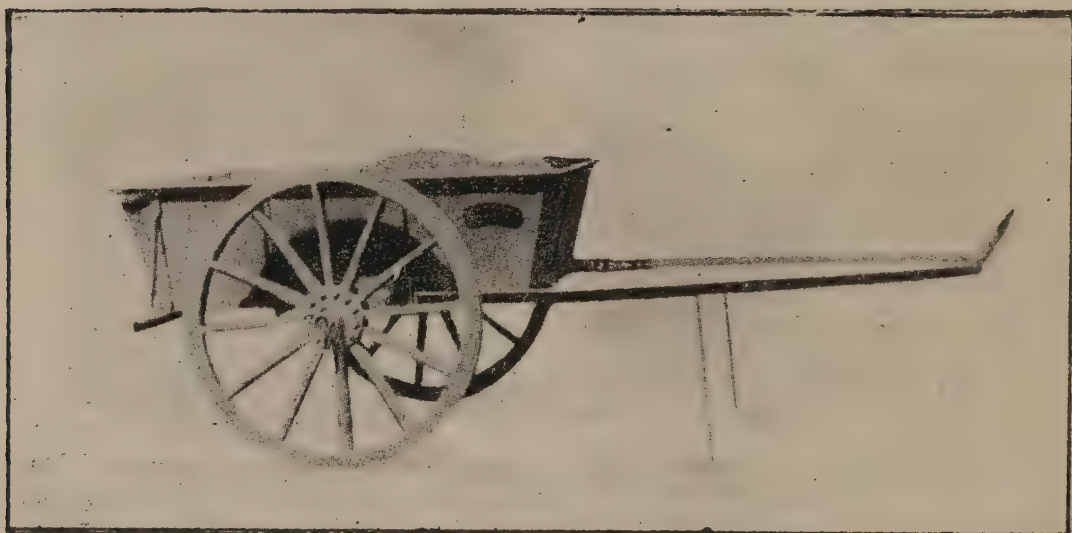


Fig. 2. Open Refuse Cart (made entirely of iron).
(Empire Engineering Co. Ltd., Cawnpore).

30 cubic ft. in capacity—which is the most popular size—with iron wheels is about Rs. 145, whereas those made of corrugated iron with wooden wheels can be had for ten or fifteen rupees less.

For removing *goala bustee* or cattle shed refuse, which is more or less of a liquid nature, consisting, as it does, principally of urine and washings with very little dung, special carts (same as nightsoil carts) are employed. The carters remove this foul liquid from the vats or pits to the sullage carts by means of buckets. It could best be disposed of by trenching or by applying over some agricultural land as it has the power of enriching the soil. In Manicktala the cultivators and gardeners often buy it at the rate of 16 cart loads (each cart containing 110 gallons) to the rupee. The dung is not—except perhaps in wet weather when it can be disposed of by trenching

or pitting—ordinarily rejected but made into cakes (*ghutia*), dried in the sun and afterwards used as fuel.

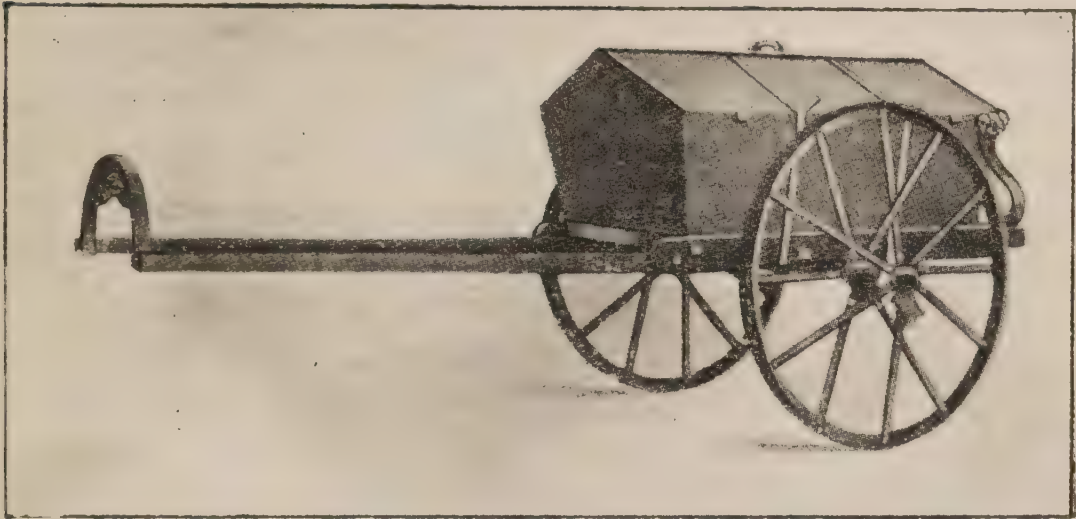


Fig. 3. Covered Cart for carrying refuse through streets.
(Civil and Sanitary Engineering Co., Calcutta).

All carts should have their numbers permanently marked or painted on them, and there should be a register in which the following particulars concerning them should be entered ;—

1. The number.
2. Date of purchase.
3. Maker's name and price.
4. Where worked (name of ward or circle).
5. Name of the carter in charge.
6. Number of the animal drawing it.
7. Notes on repairs—details as to the date, nature of the work done and cost.
8. Remarks.

The animals as well as the sanitary appliances should also be numbered or branded.

In Calcutta the working hours of refuse carters are from 4-30 A.M. to 10-30 A.M. in the summer and from 5 A.M. to 11 A.M. in the winter (November to February), and from

2 P.M. to 5 P.M. for afternoon carts. The carters immediately after muster drive direct to their blocks, where they receive from the block sircar a printed ticket, which he is required to present to the time-keeper at the end of every trip to the refuse platform or incinerator. The time-keeper punches the ticket in the space provided for the purpose and when the carter has completed his trips he will hand in the punched ticket to the time-keeper at the gowkhana. If the ticket indicates that the full number of trips has not been made the carter will be dealt with by the superintendent in charge of the gowkhana.

OTHER SANITARY APPLIANCES.

Wheelbarrows.—These are small vehicles worked by the coolies themselves and used for removing refuse from narrow lanes and passages, as in the case of bustees. Each wheel or hand barrow should be placed in charge of a cooly who would pick up and remove refuse and, if necessary, sweep the lanes. The body, which is made of galvanised iron, is supported on an iron framework provided with either a small iron wheel at the front or a pair of them at the sides. Each has a pair of handles behind and a capacity of about 5 cubic feet. The

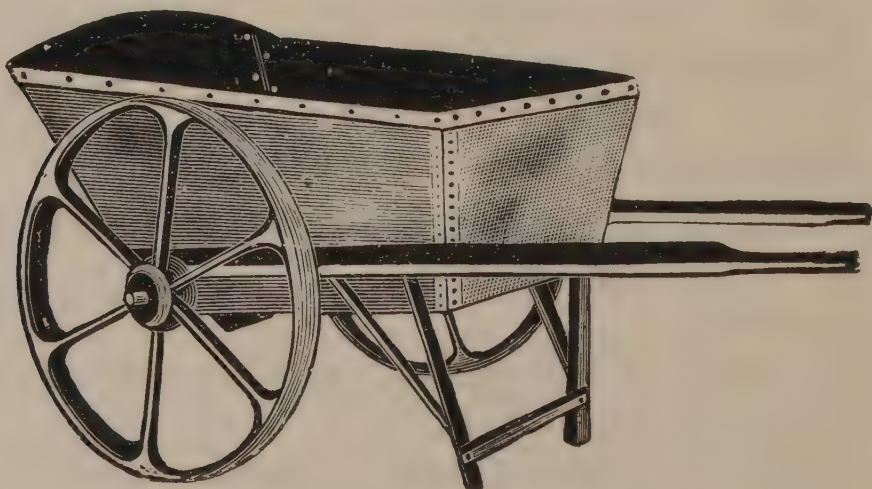


Fig. 4. Double wheel or handbarrow.
(Empire Engineering Co. Ltd., Cawnpore.)

cost varies according to size and that of an ordinary one ranges from Rs. 20 to Rs. 25. With proper care a wheelbarrow should last for about a couple of years. The repairing charges may be estimated at about Rs. 2 annually.

Baskets.—Cane baskets are superior to the bamboo ones as they are more durable. Ordinarily three baskets can be had for a rupee and one lasts for about three months.

Kodalis etc.—These are principally used for scraping drains and cutting trenches but are also used by carters for picking refuse. A dozen of ordinary-sized kodalis or spades cost about Rs. 9, and one should last for about 12 months. In Calcutta they are issued every six months, as in scraping the kerb and channelled drains they wear away very soon. *Rakes* and *forks* are ordinarily used for emptying the refuse carts of their contents and also for spreading rubbish.

Horse-dropping pans.—These are used for removing animal droppings from the streets. They are made of galvanised iron and fitted with a handle. Each is about a foot square and costs about R. 1-8 and lasts about three months.

Broomsticks.—The sticks should be about 3 ft. long and each bundle should contain a seer of them which costs about one anna. One seer by weight is ordinarily issued to every sweeper once in a month.

Brushes.—These are used for cleansing pucca drains and sometimes the road surfaces. They should be hard and one usually lasts for about a month. They are of different lengths and the 6" long ones cost about Rs. 9 a dozen.

The sanitary officer should recover all old and worn out appliances from the sweepers before issuing them new ones. In case of default the price should be recovered from their pay.

Estimation of the Quantity of Refuse.—This is rather a difficult problem, as much depends on the habits and the nature of the people. The amount of dry refuse obtainable

per head of the population in the principal towns of England, say for instance, London, has been estimated at about a pound and a half per day, whereas in Bombay it has been calculated at about a couple of pounds (1 seer) per head daily. The total amount of refuse dealt with in Calcutta, which had a population of 896,067 during the year 1914-1915, amounted to 390,921 tons. This works out at the rate of about a seer and a third, or two and two-third pounds per head per day, or about a maund (40 seers) per head per month or 12 maunds yearly. The reason of the increase in this country is due to the fact that the people are mostly vegetarians and consequently more vegetable remains, as for example, waste from sugar cane, maize, cocoanut etc., go to add to the bulk and weight of the refuse ; moreover vegetable refuse is not usually burnt in the grating as is ordinarily done in England. Besides rejected earthenware pots used for cooking and drinking, leaves of plantains and other leaves used as plates or receptacles for food especially on festive occasions, weeds from tanks, thatch or *golpatta* from the roofs of huts etc., add considerably to the bulk of refuse. Hence for practical purposes one seer of refuse per head per diem in the moderate sized towns in India is a fair estimate. But in smaller towns, which are yet passing through the stages of evolution, the conservancy or the cleansing arrangements are not up to the standard and consequently the quantity of refuse collected per capita is considerably less or even only one-half to that of the big towns, which are more or less trade centres and where the arrangements for the removal of refuse are more perfect and well organised. Calculating on this basis (1 seer per head) about $\frac{1}{3}$ ton or 9 maunds of refuse per head per annum, or roughly about one ton per 1000 inhabitants per diem, requires to be dealt with in towns of any importance ; while in the case of smaller towns, where the cleansing arrangements are much less efficient and where most of the vegetable refuse and

waste food are utilised for feeding domestic animals like cows etc, the amount of rubbish requiring removal necessarily becomes lesser still and may be computed at about half a seer (one pound) per head or a ton to every 2000 of the population daily.

Estimation of the number of Carts and Animals required.—To work out with any degree of certainty the total number of carts and animals required, the population of the town, the quantity of refuse to be dealt with and the distance to be traversed for disposing of the refuse should first be ascertained.

An ordinary refuse cart of 30 cubic feet in capacity will remove at each trip about half a ton (nearly 14 maunds) of refuse. A cubic yard (27 cubic feet) of refuse in India usually weighs from 8 to 10 cwt. (1 cwt = 56 seers or 1 md. 16 srs.) according as the refuse is of a hollow or of a compact nature. The amount of work which an ordinary bullock can do during the hours of working in the morning is to travel about 5 or 6 miles with the cart (including stoppages for picking up refuse) on a fairly decent road. This, under ordinary circumstances usually means two to three trips—the trips principally depending on the lead. But if the cart is detained unnecessarily at the place of unloading, or if the carters loiter, or again if the dumping site is at some distance, the trips will necessarily fall short in number and therefore for working purposes they may be assumed to be only two. This has also been amply borne out in practice ; hence one cart is calculated to remove one ton of refuse a day, or, in other words, one ordinary sized cart is required for every 1000 people in a big or for every 2000 in an ordinary mofussil town. Therefore for a small municipal town having a population of say 15,000, which would produce about $7\frac{1}{2}$ tons of refuse daily, 8 carts and an equal number of bullocks and carters would be required if efficient scavenging is aimed at.

Buffaloes work twice as much in so far that they draw heavier loads, but they cannot make more trips than an ordinary bullock. Under normal circumstances a pony can do about three trips.

Labour Staff.—Experiments carried out in Calcutta showed that a sweeper or *dhangar* could sweep clean 8000 to 9000 square yards of road surface every morning during their prescribed time of working. But in mofussil towns where the amount of rubbish to be collected is small, and where the sweepers do not sweep the roads thoroughly but only scrape those portions which require attention, each cooly can attend to considerably more or even double the area. Generally one cooly is placed in charge of every mile of the length of the road, but for satisfactory cleansing one sweeper for every third of a mile of the main roads is to be calculated upon—the width of the roads ordinarily taken to be about 30 feet.

For the drains the number of coolies required depends on their nature and size. In 1912-13 at Howrah there were 24 miles of pucca drain for which 70 coolies and 31 bhistis were employed, so that each cooly cleaned about 600 yards of the length of the drain, the bhistis simply pouring water from their *mussaks* or leather bags to facilitate the cleansing operation. Again, in the same year there were about 130 coolies to look after and clean 80 miles of *kutchha* (non-masonry) drain, i. e., each cooly attended to about 1080 yards of the drain daily. Experience, however, shows that a sweeper can clean satisfactorily about 1,000 running feet of an average-sized pucca drain and 200 to 300 ft. of *kutchha* drain every morning. The length of a *kutchha* drain to be cleaned depends on its width and depth and also on the amount of silt and jungles or vegetations to be removed from it. So the total number of coolies required can only be definitely ascertained by carrying out actual experiments under proper supervision.

The number of wheelbarrow men depends on the area

and the amount of sweepings to be collected. The wheelbarrows are especially required for cleaning the *bustees*, which are usually interspersed with very narrow and winding lanes and passages, and one man may ordinarily be calculated upon for every 500-600 of the bustee population. For each cart one animal and a carter is required.

Estimation of the cost for removal of refuse.—

Removal of refuse is ordinarily effected by carts, bullocks and carters. The average cost of a wooden refuse or scavenging cart is about Rs. 140 and with ordinary care one lasts for about five years. One bullock costs about Rs. 50 and its serviceable life may on an average be estimated at 5 years. The cost for removing a ton of refuse may therefore be worked out in the following way :—

Items	Average yearly cost.		
Cost of a bullock	Rs. 10	0	0
Feed for a bullock @ 8/8/- monthly...	„ 102	„	„
Shoeing charge @ -/4/- per month ...	„ 3	„	„
Veterinary charge @ Re. 1/- per month	„ 12	„	„
Cost of a 30 cubic feet refuse cart ...	„ 28	„	„
Repairing and greasing @ Rs. 2/- per month	„ 24	„	„
Carter's pay @ Rs. 9/- per month ...	„ 108	„	„
Stabling accommodation @ -/12/- per month per head of cattle ...	„ 9	„	„
Accommodation for carters @ Re. 1/- per head	„ 12	„	„
Miscellaneous charges for baskets, ropes, kodalis etc, @ -/8/- per month	„ 6	„	„
<hr/>			
Total	Rs. 314	0	0

Hence the annual charge for removing 365 tons of refuse—as one cart is calculated to remove in two trips a ton of refuse daily—is estimated at Rs. 314-0-0. Therefore the average cost for removing one ton of refuse (or the refuse for every 1,000 of the population in a mofussil town) comes to 13 annas 9 pies (as against Re. 1-6-7 worked out for the city of Bombay). The total expenditure incurred for the year 1914-15 by the Corporation of Calcutta under the heads street cleansing, incineration and municipal railways amounted to Rs 10,35,500, for the collection, removal and disposal of 390,921 tons of refuse. This works out at the rate of Re. 1-2-6 per head of population or Rs. 2-10-6 per ton of refuse dealt with.

CHAPTER III

DISPOSAL OF REFUSE

The importance of satisfactory disposal of all rubbish can scarcely be exaggerated, and the methods adopted vary with local circumstances ; but the tendency of sound municipal administration is to get rid of all refuse at a profit. It is a mistake to look upon house and trade refuse as mere waste : most of it consists simply of materials put in the wrong place.

There are two principal ways of disposing of refuse, viz :

I. Dumping and

II. Incineration or destruction by fire. This is the most sanitary way of dealing with refuse.

Dumping.—This consists in filling with refuse pits and hollows in the ground, or marshy places, or raising the level of low-lying lands (reclamation). This method is of the primitive nature and the one that is universally adopted in India. The practice gave rise to a good deal of controversy, some condemning it, while others were just as positive in its favour. It, however, cannot be said to be inoffensive, but experience has shown that no great nuisance is caused if the refuse is laid *dry*. The area to be reclaimed should be well away from human habitations and water courses. The site thus obtained is known as *made soil*, which is purified by bringing under cultivation preparatory to its utilisation as site for buildings, and the selling of this right of cultivation is a source of income to the municipality. The low lying marshy plot of land to the east of Calcutta, known as the Salt Water Lake, which comprises an area of about one square mile (1,960 bighas), is being gradually filled up by

sweepings and most of the vegetables consumed in Calcutta are grown there. This area, popularly known as Dhappa, was acquired in 1864 for dumping and embanked at a cost of Rs. 93,590.

Organic matter in a *made* ground disappears very slowly and no such soil should be used as a building site until all the organic matter has been completely disintegrated. This process of disintegration takes a long time and may extend from 10 to 20 years or even more according to the nature of the refuse dumped.

Although the best materials for filling up insanitary tanks, *dobas* (excavations) and other hollows in the ground are clean earth, or other suitable materials such as cinders or *debris* from dismantled houses, yet these are not always used as they are costly and difficult to obtain. People consequently take advantage of street rubbish which is cheap and more easy to procure. The cost for cinders in and about Calcutta is about six times and of clean earth about nine times more than that of street rubbish which the municipal authorities of Maniktala (adjoining Calcutta) sell at five rupees per 1000 cubic ft. (inclusive of carting charges). The rate varies with different Municipalities and in some towns refuse may even be obtained free of charge. Of course during the deposit of refuse a temporary nuisance is caused but a foul tank in the midst of a *bustee* or inhabited locality is a source of greater danger than a temporary nuisance occasioned by filling it. But such a nuisance can to a great extent be obviated by adopting the following precautions :—

(1) The tank should first be dewatered completely in order to lay the refuse as dry as possible. If the tank is a big one it should be partitioned off either by means of bamboo matting or an earthen dam and each part taken in turn. It must be protected by a suitable embankment if it is subject to flooding.

(2) The daily deposit of refuse should be covered over by a layer of clean earth about six inches deep to prevent the breeding of flies and the scattering of the lighter particles of sweepings by the wind. Sprinkling of kerosine oil or tar helps to keep away flies.

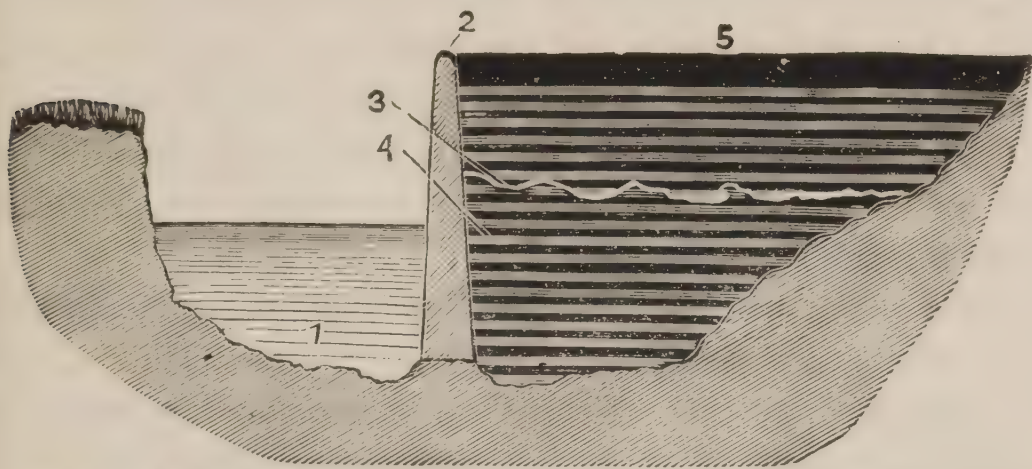


Fig. 5.—A big tank being filled up by compartments. 1. Unfilled portion of the tank containing water. 2—Partition wall. 3 and 4—Layers of sweeping and earth laid alternately. 5. Top dressing of clean earth.

(3) No dead animals, slaughter-house garbage or faecal matter should be thrown into the hollow.

(4) The deposit of refuse should be systematic, commenced at one end and gradually pushed on to the other.

Unless the above mentioned precautions are taken the deposit of refuse usually becomes a fruitful source of nuisance. Foul gases are given off from the decomposition of organic matter and the liquids draining from the heap are of a very noxious character, causing serious pollution of the neighbouring sources of water supply. Again such a refuse or muck heap harbours rats and breeds flies which invade the houses near by. Moreover on windy days the lighter particles of refuse are carried about much to the annoyance and disgust of the people residing in the locality.

It is not prudent for a municipality to undertake to fill up a tank unless it can guarantee the completion of the work before the onset of the rains. This question can easily be

solved by first ascertaining the area of the hollow in cubic feet and estimating the amount of refuse available daily in that section or beat for its deposit there ; then by dividing the former by the latter figure the total number of days that will be required for filling up the excavation will be ascertained. The work should be commenced after the rains are over, *i.e.* in the latter part of October and finished before the setting in of the monsoon, that is, by the middle of June next ; if the tank is found big enough to be completely filled during this period it should be suitably partitioned off and each portion taken up in turn.

One of the drawbacks to the disposal of sweepings in this way within a town is the difficulty of getting earth to cover the deposit, but this difficulty can be overcome by having a sufficient quantity of earth dug beforehand from the sides and bottom of the hollow where the sweepings are to be thrown. If at any time during the continuance of the work the deposit becomes offensive it should at once be coated over with a thick layer of fresh earth and the depositing of further sweepings discontinued until the nuisance has abated. With proper precautions and supervision no appreciable nuisance should occur except during the rains, even when the deposit had been continued for several years.

The dropping of refuse must be discontinued when the ground level is attained and the deposit then covered over with a thick layer of clean earth so as to raise the area about a couple of feet above the adjacent ground level in order to provide for an allowance for future settlement. The site so obtained should not be used for any purpose other than gardening, cultivation or cattle grazing until it becomes quite suitable as a building site.

When an application for filling up a tank or hollow with refuse in or near an inhabited locality reaches the sanitary officer, he should, before making any recommendation, always

inspect the site and its surroundings thoroughly and satisfy himself that any temporary nuisance that might arise would not affect the health of residents of the place, as well as any water supply near by. Each case must, however, be judged according to its own merit, but for practical purposes it may be said that a recommendation, subject to the conditions mentioned before, may be made if the minimum distance between the foul hollow or tank and the neighbouring dwelling houses or water-courses be not less than fifty feet. He should at the same time see that there is a decent passage leading up to the site for dumping in the interests of the carts and the animals drawing them, and in its absence all grant of sweepings should be withheld. He should regularly inspect the progress of the work and satisfy himself that the conditions are strictly adhered to and that no nuisance is produced.

All charges for the rubbish should be deposited in advance. In Howrah, where the price of land is rising very fast, there is a great demand for sweepings which are sold at the rate of rupees three only per 1000 cubic feet and it takes two years or more to supply sweepings to those persons already registered in the books.

The *advantages* derived from filling up foul tanks with street sweepings may be summarised as follows :—

- (1) A large number of foci for diseases like Malaria, Cholera, Typhoid Fever etc. are removed.
- (2) Facilities are afforded for the disposal of refuse without the expense of a long journey.
- (3) Valuable sites for either building, business or cultivation are prepared at a small cost.
- (4) A considerable amount of assessable property and consequently an increased rate is obtained, and
- (5) A source of danger to children is removed from the heart of the *bustees* and sides of the roads.

At the hill station of Darjeeling all street and dustbin refuse is removed for disposal in quite a novel manner. There is a cable way which is worked by electric power. The receiving depôt is at a convenient centre in the bazar at the edge of a steep incline and the refuse, as received, is piled into the swinging cars which can be slung by two men. The cable is on the endless system passing round a pulley, and as the loaded cars descend a fresh supply of empties comes up from below. The dumping depot is about 400 feet below, and refuse is tipped out into a *jhora* and is burnt or washed down by rain. The depot is at a sufficient distance below to avoid nuisance. The system has never broken down and is in good working order.

Incineration or destruction of refuse by fire.—

This is the other method of disposing of refuse. Burning has now been recognised as the safest and the most sanitary way of dealing with all refuse. It is in most cases the easiest and cheapest way of getting rid of rubbish, which is reduced to about a third or quarter of its original weight, and the clinker thus obtained is used either for road-making or filling purpose, or as a medium for filter beds of septic tanks. By heating and treating such clinker with tar, pitch and bitumen, as is done in some places in England, *e.g.* Fulham, Hornsey, etc., good roads may be made. These have a fair life and are economical to maintain and capable of carrying heavy motor traffic such as motor buses. When refuse is burnt much of its manurial value is lost.

The nature of the rubbish in Indian towns or villages differs much from that of the European ones as it hardly, contains any combustible material in form of coal or wood. Colonel Clemesha in his book on the "Sewage Disposal in the Tropics" says: "There is an impression abroad that street rubbish, in any part of India, is an inflammable substance. This is a serious error. The street rubbish from

the towns in Bengal will not burn ; it requires wood or coal in order to burn it, even when put in the latest pattern incinerator. The same remark applies to rubbish obtained from the towns on the Malabar Coast. In places like the Punjab, where the rainfall is extremely small, it is quite likely that street sweepings will be highly combustible, but this should be definitely ascertained before the recommendation is made. The rubbish that is collected during the rains in any part of the tropics will not burn." Hence in order to completely burn all rubbish it is necessary to add to it some inflammable substance, e.g., coal dust, wood shavings, dry leaves etc., or to separate by hand, rakes and forks the combustible materials from the non-combustible ones, e.g., brickbats, broken earthenware, broken bottles, tin, iron scraps etc. The combustible materials should then be transferred to the incinerator, while the non-combustible ones utilised for filling purposes. Instead of rejecting all dung and bedding of animals from the municipal gowkhana, it would be economical to utilise them as fuel for the incinerator after drying them in the sun, and any excess should be carefully stored for use during the wet weather.

It is better to have a number of smaller incinerators conveniently located than a big one situated perhaps at one end of the town, because large ones are very expensive to work, particularly so in this country owing to the non-inflammable nature of the sweepings. The incinerators should be constructed on a raised plot of land not subject to flooding. These can be located near inhabited quarters as refuse properly cremated in well-designed incinerators hardly creates any nuisance. Attached to each incinerator there should be a yard where refuse could be spread and dried prior to burning. It is necessary to have a well covered shed for storing all dry refuse and fuel. In small incinerators it is not necessary to employ any other than coolie labour,

and the ashes that fall to the bottom should not be altogether removed, but allowed to accumulate as high as the fire-bars as the great heat which they give out helps to destroy the smoke in the furnace. The door for receiving rubbish and

also for raking it is usually placed at the top of the incinerator. There should be a raised platform or steps from which the refuse can be conveniently shovelled through the top door.

There are various types of incinerators in use but ordinarily a furnace with a chimney to let out the smoke is all that is wanted. Such an incinerator is not only very simple in construction but very easy to work. The description (*vide* Proceedings of the Second All India Sanitary Conference) given by Dr. Macdonald, Health Officer of Madras, of small incinerators, of which quite a

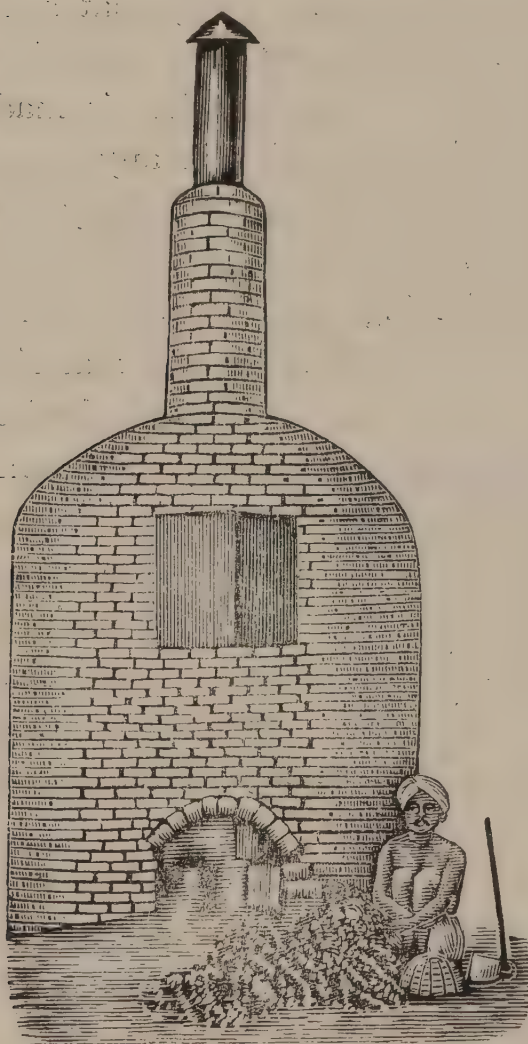


Fig. 6

An Ordinary Small Incinerator.

good number is in use in that town, is as follows:—

“The structure is a brick masonry one with three rows of iron bars superimposed and each row placed at right angles to the other, in the bottom of the furnace ample draft apertures are allowed for, below, and above is an upright masonry chimney on which is usually placed a 12'-16' iron chimney, an iron lid with a baffle plate is placed over the furnace, which is opened and closed by means of a wire

pulley attached high up on one side of the masonry chimney. The cost of erection is a recommendation also, as the masonry work is only Rs. 100, Rs. 25 for the iron chimney.

The monthly cost for the staff working at such an incinerator is only Rs. 21 per month (three coolies at Rs. 7 each) as compared to Rs. 384 per month at the large incinerator."

In Colombo, where a destructor is employed of the Horse-fall type equipped with an apparatus for heating oil fuel for use with wet rubbish, the cost for destroying a ton of refuse varies between Re. 1-30 cents and Re. 1-50 cents, and the furnace residue by weight amounts to about 40 per cent. of the total rubbish burnt. This method of disposal has effected a saving of 16 per cent. in the rubbish transport charges.

The quantity of rubbish disposed of by small incinerators in Madras in course of a year, according to Dr. Macdonald, is as follows :—

"This works out at about $11\frac{3}{4}$ cart loads per day for each incinerator during the year (1911-12). Experiments conducted to ascertain the maximum working efficiency of each, however, shows that up to thirty cartloads of sun dried rubbish can be disposed of during a working day. Fifteen cartloads per incinerator per working day have been found not to overtax the energies of the coolies employed in separating, screening, stoking operations and reclamation work ; but under favourable weather conditions to increase the consumption of rubbish all that is required is to strengthen the working staff by two or three extra coolies. The percentage of ash to rubbish is about 33 per cent."

The *advantages* derived from the use of small incinerators can be summarised as follows :—

1. Sanitary disposal of rubbish.
2. Reclamation of tanks and insanitary low lands.

3. Reduced cartage charges, and
4. Less expensive to work.

Incineration in Calcutta.—Refuse from the southern section (District IV) of Calcutta, which has a population of nearly a couple of lakhs, is disposed of by burning in an incinerator of the Harrington type at Goragatchia. This has been working since 14th August 1892 and was erected on Corporation land at a cost of Rs. 49,000. The height of the chimney shaft is 134 feet. To facilitate the combustion of refuse during the rainy months and to work the washing apparatus and crematorium, provision has been made for a donkey pump and a large revolving fan, actuated by an engine, which receives its supply of steam from the boiler.

Each cell or furnace can burn on an average about 12·5 tons or 500 cubic feet (40 cubic feet of refuse a ton) of refuse in wet weather and more in dry weather, during 24 hours of continuous work.

Fuel is used only on rainy days when an average of one maund of coal for each furnace has to be expended in order to keep up the fire, 10 or 12 maunds of steam coal being used in order to drive engine and pumps. During eight months in the year the incinerator can be used without coal, unless the fan is required for disposing of the refuse quickly. The cost of burning, excluding sinking fund and including establishment and working charges, is estimated at annas four and pies nine per ton. The outturn of ashes and clinkers is about twenty per cent. of the refuse burnt and these are utilised for filling purposes. About a tenth of the total refuse of Calcutta is disposed of at the Goragatcha incinerator. The ashes and the clinkers are sold at the rate of Rs. 7-8-0 per 1000 c. ft. (exclusive of cartage). (The incinerator has recently been abandoned as the land on which it stood has been acquired for the extension of the Calcutta Docks.)

There are a number of brick-built small incinerators at Barrackpur in which all rubbish collected from the cantonment area is burnt along with the dropping and bedding of animals and human faeces obtained from the barracks.

In seacoast towns where the sweepings are barged from wharves and discharged into the sea much nuisance is occasioned both at the wharves and along the shore.

REFUSE DISPOSAL IN RURAL AREAS.

In non-municipal towns or villages where no organised scavenging system exists the disposal of rubbish presents considerable difficulty, but it can be disposed of in a reasonably satisfactory way with a little care and attention on the part of the residents. All vegetable refuse such as potato peelings, skins of fruits, cabbage leaves, waste from sugar cane, maize etc., can be burnt in the grate or hearth, or used as food for cattle ; remains of food such as fish offal and other kitchen refuse can be disposed of by trenching in the garden. Rice water, which is usually rejected in Bengal, can be best utilised as food for domestic animals by mixing with a little salt and vegetable refuse. A large proportion of the villagers keep cows, and their dung during the eight months of dry weather can be satisfactorily disposed of by making cakes for purposes of fuel, while in the rainy weather by trenching or pitting in some open land or cultivated fields, as it has a high fertilizing power ; the urine and washings should be removed in pots or tin canisters and deposited on any agricultural land. Dung etc., should on no account be allowed to be stored on the premises nor thrown at random anywhere and everywhere in the village. Such refuse not only harbour rats and other insects but also breed flies which play such an active part in the propagation of diseases like cholera, typhoid fever etc. Papers, rags, old mattresses, broken chairs, rejected bedding, etc., can be disposed of by burning along

with all jungly growths removed from the garden or compound. Weeds removed from tanks should not be allowed to rot on the banks but carted away at once. Dry leaves can be used as fuel. All broken pots, *handis* or earthen pots, tins, etc., should be used for filling hollows, but these should be so broken or distorted as to render them quite unfit for lodging water for the breeding of mosquitoes. Ashes can also be used for filling purposes. Remains of cocoanut should not be thrown about here and there as they hold up water, but utilised as fuel after cutting them into thin strips and drying in the sun. In short all refuse that could be burnt should be burnt and those that can not be so treated should be disposed of by burying in the ground.

In the Union Committees under the District Boards, a small beginning has been made for conservancy work for which a grant is given to them by the Boards. Moreover, to encourage these Committees in their sanitary undertaking the District Boards contribute a liberal sum for every rupee they levy as sanitary tax.

Every villager should do well to keep the road in front of his house clean and free of dust and should also see that no body performs offices of nature on the village streets or lanes or on the banks of tanks or rivers.

CHAPTER IV

DISPOSAL OF CARCASSES

The special establishment (of *domes*) maintained by municipalities should move daily in the morning through all the streets and lanes of their respective beats and forthwith remove all carcasses lying on them. The carcasses of small animals, e.g., dogs, cats, rats, etc., are best collected in strong canvas or tarred gunny bags. In Calcutta and in some of the municipalities the task of removing all carcasses is entrusted to contractors, who are required to finish their work within a specified time, usually by ten o'clock every morning. The conservancy officer should always report any neglect or default on the part of the contractors to his chief and also arrange for immediate removal of carcasses in hired carts and realise the cost from the contractors.

The carcasses of big animals are removed in special carts (carcass carts). The *carcass cart* should have its interior lined with some metal plate as thin sheet of zinc or tin to make it thoroughly non-absorbent and its cleansing easy. It should, as far as possible, be kept in waiting in such a place as not to cause any offence to anyone, and all carcasses collected by the *domes*, who are the only class of people in India who would touch the dead bodies of both men and animals, should be deposited in the cart.

As for private carcasses the occupiers of premises upon which an animal dies, or the person in charge of an animal which dies in the street, may cart it to the place of disposal. The municipal authorities should be prepared to remove private carcasses also. In Calcutta all owners, if they are

not prepared to remove the carcasses, are bound to give notice and to deposit a prescribed fee for their removal to the Municipal office.

Carcasses can be disposed of either by burying or burning. Burial should be done in isolated places about 5 or 6 feet below the earth to prevent jackals and other animals from bringing the body out. The carcasses of animals dying of infective diseases should, if fuel be available, always be burnt; if not, the body should be buried after the skin has been well slashed with a knife so as to render it quite useless. This is a necessary precaution against the spread of infective diseases, as the *chamars* or *moochies* who deal with hide, generally dig open the graves for the skin. The Municipality should always set apart a place for the burial of carcasses.

A carcass is best burnt in a trench dug in the form of a cross. The cutting point of the trenches should be at least three feet deep and wide enough to accommodate the carcass. The trenches should gradually be made shallower from the central point towards their extremities and each arm should be about 8 feet long. This is necessary for properly feeding the fire with air. The carcass should be burnt after placing it in a bed of fuel at the central hollow. About 15 to 20 maunds of wood will be required for an average sized carcass and the time usually taken to reduce it to ashes is about 6 hours.

In Calcutta the carcasses of the big animals, *e.g.*, cows, horses, buffaloes, etc., are taken to the contractors' skinning platform at Dhappa, about 4 miles to the east of the town, where the skins are removed, while those of the smaller ones, *e.g.*, cats, dogs and the like are usually thrown in an open place near by to be disposed of by vultures and other scavengers of nature. Carcasses carted to Dhappa are always accompanied by *chalans* to prevent the carters from bartering with them in any way.

PART II
CONSERVANCY

CHAPTER I

INTRODUCTORY REMARKS

This system deals with the removal of human excrement by hand and as such it is also known as the *hand removal system*. The primary object of this system is to get rid of both the solid and the liquid excreta from the house and its neighbourhood as quickly as possible without allowing decomposition to set in. Excepting a few big towns like Calcutta, Cawnpur, Benares, Bombay etc., which are more or less sewered, the removal of excreta by hand is in vogue throughout India, as small Municipal towns for want of sufficient funds cannot introduce the water-carriage or the wet system of sewage removal, which is the cleanest, readiest and most efficient way of dealing with the excreta. As no water is used for removing the excreta in the hand removal system, this method is also called the *dry method*, as distinguished from the *wet method*, of sewage removal. Adequate arrangements should always be made for the daily and complete removal and also for the disposal of human excrement or nightsoil (so called because in cities it is removed at night), as accumulation of filth means pollution of air, water and soil, and consequent diseases. The enforcement of the regulations controlling the construction of privies and latrines also form an important duty of the conservancy department, and the various Provincial Governments issue from time to time circulars and instructions for the proper management of the conservancy work. The working of this system depends solely on the way in which the scavengers or *methers*, who are in this country the only class of people who would handle or touch nightsoil, work.

In each Municipal town there should always be an adequate number of public latrines, and it is desirable that every house should be provided with a privy. In Bengal a distinction is ordinarily drawn between a *latrine* and a *privy*—"the former imports public convenience and the latter applies to private places" (*vide* Calcutta Gazette Supplement May 9, 1894, page 807). A list of privies and latrines should always be kept in the Municipal office. The establishment employed for cleansing public latrines should be kept absolutely separate from that of the private privies, as a special fee—known as the conservancy tax or latrine fee—is levied on the householders for the maintenance of the special staff of methers.

Faecal matter undergoes rapid decomposition when mixed with urine with the formation of carbonate of ammonium which renders it alkaline. It is, therefore, necessary to keep it separate from urine ; moreover this separation facilitates its collection, removal and disposal, whether by trenching or by burning. This is a point of great importance and should always be noted in the construction of a privy or latrine. Patent separators made of galvanised iron can be had in the market and by using these an ordinary latrine converted into one of the separation system type at a comparatively low cost. It is a good plan to cover the faeces with a handful of dry powdered earth or ash, which is a good deodorizer, after each visit to the privy as is the practice in the jails, but the use of disinfectants should be discouraged as they appear to act injuriously on the nitrifying organisms after the trenching of nightsoil.

Every sanitary or conservancy officer should personally supervise the work of the methers and see that all filth is regularly and completely removed. He should also see that all privies and latrines are in efficient order and take measures to have their defects remedied. Section 224 of the Bengal

Municipal Act gives the Municipality ample power to deal with any inefficient or defective privy, and section 231 with any unauthorised construction, or privy not constructed according to sanction.

The methers or *bhangis* should, as in the case of the sweepers (coolies etc.) be mustered early in the morning so that they can commence work just at daybreak. They must finish their work as quickly as possible. The service of a few of the methers should be engaged in the afternoon to do the work of those who absent themselves in the morning, or better still the work of the absentees should be judiciously distributed among those who come to work. The methers must be summoned periodically (say once in a week or 10 days) in the afternoon to tar the buckets and carts. The mether staff requires to be carefully watched as they very often succumb to the temptation of emptying their pails in the nearest jungle or ditch instead of carrying them to the trenching ground. (*Mether* literally means a chief ; the scavengers are so called by way of flattery).

CHAPTER II

PRIVIES AND LATRINES

Eggs or ova of intestinal worms such as ankylostoma (hookworm) and certain disease germs like those of enteric fever, cholera, dysentery etc., leave the human system along with the bowel excretions, and are capable of reproducing the disease when carried into the system along with food or drink. It is therefore necessary to prevent people from easing themselves anywhere and everywhere at their pleasure from health considerations. During the rains the surface washings contaminated with human excrement find their way into tanks etc., and so pollute the supply of water. Moreover, flies, which are very partial to human faeces, invade food-stuffs after feeding on filth and so help to propagate such dangerous diseases as cholera, typhoid fever etc. Hence the necessity to have fixed places—privies and latrines—for answering the calls of nature. And such a procedure also helps in the easy collection of all excrement by the scavengers or methers. As the services of methers are engaged for cleansing the privies, they are often called “service or hand-removal privies.”

Almost all privies are constantly offensive, especially in hot weather, and that people from habit do not ordinarily notice the nuisance which is injurious to their health. Privies usually become foul and productive of nuisance if they are constructed of improper or absorbent materials, such as wood, or when they become old or delapidated and also from want of repairs or cleanliness. Even newly-built privies cause nuisance from misuse or from the spilling of filth on the floor during the cleansing process ; this is practically unavoidable,

no matter how careful the methers may be in their operation.

All local authorities generally frame rules or bye-laws regulating the erection of privies and urinals, but the underlying principles are, in every case, the same, *viz.*, the prevention of nuisance and improvement of sanitation of the town.

The **principles** that should govern the construction of all privies and latrines are as follows :—

(1) The *design* should be such that all solid excreta and liquid filth (urine and washings) should speedily and automatically find their way into separate receptacles without any human intervention.

(2) The *materials* entering into their construction should be of a non-absorbent character so as to prevent the pollution of soil and subsequently of water through soakage.

(3) There should be proper *arrangements to exclude rain* and flood water.

(4) They must be properly *enclosed* and have apertures for efficient *ventilation* even when the doors are closed.

(5) There should always be a direct and decent *access for the scavenger* or mether.

PRIVIES.

Selection of Site.—A privy should always be a detached structure and located at a distance of about six feet from any dwelling room or place of business, and at a considerable distance (50 feet or more) from any source of water-supply, such as tank, well etc. If the tank or well is used for drinking purposes, the distance should be greater still. Section 230 of the Bengal Municipal Act prohibits the construction of any latrine, urinal, cesspool etc., within 50 feet of any tank or water-course which the inhabitants of any locality use. The privy should preferably be constructed on the side opposed to the prevailing wind and against the

outside wall of the premises for admitting the scavenger easily without his entering the house. For rules issued by the Government of Bengal under Section 350 (c) of Act III of 1884 regulating the construction of private privies and urinals see appendix.

Parts of a Privy and their Construction.—A good privy should consist of the following parts :—

(1) The *collecting chamber* containing the receptacle for nightsoil.

(2) The *platform* or the seat arrangements.

(3) The *superstructure*, i.e., the structure above and enclosing the platform, consisting of walls, partitions and roof.

(4) The *cesspit* or the receptacle for wash-water and urine.

The **collecting chamber** consists of the lower portion of the privy and should always be of good masonry work. Its floor should be concreted and raised about six inches above the surrounding ground level to prevent surface washings during rains or flood water entering the chamber. It should also have a gentle slope leading towards an opening on the side on which the cesspit is located for draining all washings from the collecting chamber into it. Its walls and floor should be rendered absolutely watertight by thoroughly plastering over with a thick layer of good cement, and all the corners rounded off to prevent accumulation of dirt and to facilitate easy cleansing. The dimensions of this chamber should be such as to admit one or two moveable receptacles for filth of about one cubic foot in capacity being placed and fitted beneath the platform in such a manner and position as will effectually prevent the deposit, otherwise than in such a receptacle, of any excreta falling or thrown through the aperture of the platform. The height of the chamber should be about 2 or 3 feet. A greater height is likely to cause splashing during the falling of the excreta into the receptacle.

The *trapdoor* or the cleansing door for the mether may

be fitted on any of the walls, excepting the one facing directly the road or bedroom. It should completely and tightly cover the aperture and be of such a size as to permit of an easy insertion and removal of the receptacle. The door should be fixed with strong hinges, as the methers invariably succeed in breaking through weak ones, very often from personal motives. It is very difficult to obtain mether carpenters, and even when they are available their charges for even very simple repairs are very high. The trapdoor should be periodically tarred and always kept shut. If the door has got to be constructed facing a street it should always be screened from public view by erecting a wall about six feet high, leaving a space about 3 or 4 feet wide between it and the privy for the mether.

The **platform** containing the seat arrangements must always be made of first class bricks and mortar and plastered over with cement, or made of some watertight material such as glazed stoneware, vitrified bricks, artificial stone, cast iron etc. It should have a slope of about half an inch or an inch to the foot towards an opening or drain leading to a receptacle, movable or fixed, outside in which all ablution water and urine are to be received. The *footrests* on which the user's feet rest when sitting in a squatting posture are ordinarily constructed of bricks laid on the flat and covered over by a layer of cement. There should be one foot rest on either side of the aperture, which should be at the centre of the platform, for the passage of faeces directly into the pan placed on the floor of the collecting chamber. The aperture may be square or circular and should not be too narrow nor too wide—8 to 10 inches being of convenient width, and its front and back margins should be so raised or constructed as to act as barriers to the admission of any urine or water inside ; all the sides of the opening should be thoroughly plastered with cement and made quite smooth. There should be a third

or an extra set of foot rests for use during ablution. Specially designed platforms can be had in the market at a moderate price.



Fig. 7. 20th-Century Latrine Seat (Patented). The Seat is stamped out of one steel sheet and is supported on a light iron framework. The white enamelled iron Pans are arranged to slide in at the back or in front. The pans are easily kept clean and replaced when worn out. (Empire Engineering Co. Ltd., Cawnpore).

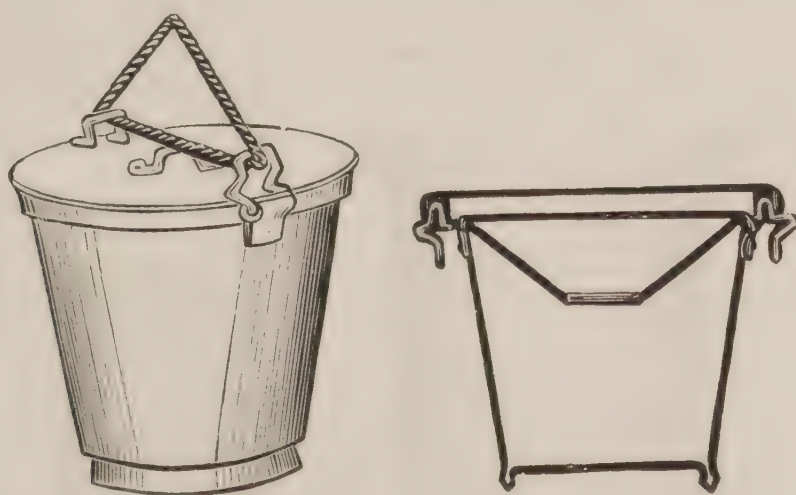
The area of the platform for a single-seated privy should not be less than nine square feet (*i.e.* $3' \times 3'$) excluding walls. A two-seated privy should be about 7 feet long including the partition wall.

The **super-structure** should be substantial and special attention given to ventilation with due regard to privacy and decency. The *walls* can be made of any material so long as privacy is secured, but usually they are made either of masonry, corrugated iron or bamboo matting (*durma* or *tat*); of these corrugated iron is recommended, as it is non-absorbent, cheap and durable. If made of bricks the inner surface of the walls up to a height of about a foot or two from the platform should be cement-coated. There should be windows or apertures for ventilation on the upper portion of the walls, and if the walls are made of corrugated iron or

bamboo matting, a space between their top ends and the roof should be left for the same purpose. Bamboo matting has nothing to recommend in it since it is absorbent, inflammable and not lasting. It is cheap at the outset but is costly in the long run, as it has to be repaired or renewed once a year or oftener,—the mats rotting rapidly during the rains. If it is used at all it should be in double or more layers and well tarred. The entrance door for the user should be of sufficient dimensions and properly fitted with arrangements to secure it both from inside and outside. The walls should be about 7 feet in height with the openings for ventilation as near the top as possible. For partitions corrugated iron or brick work should be preferred; these should run from the platform right up to the ceiling.

The *roof* should be of such a nature as to completely keep away the sun and rain. It may be made either pucca or of corrugated iron, of country tiles or of thatch, but the drawback to the last named material is that it is inflammable.

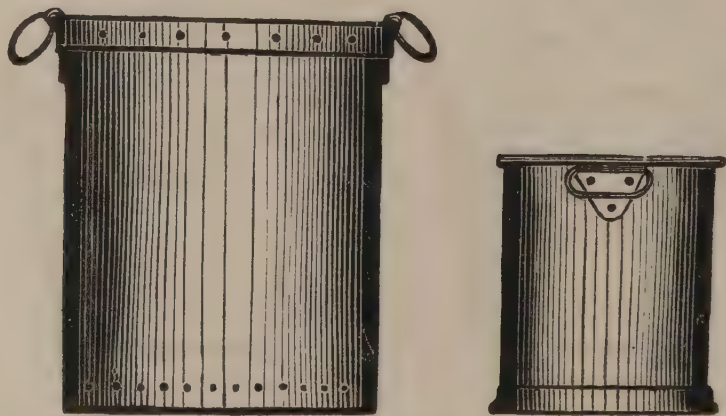
The *privy pan* or the receptacle for nightsoil should always be of a moveable nature and placed directly below the aperture in the platform. This receiving bucket may either be of



Figs. 8 and 9. Galvanised iron Anti-splash Pails (Donaldson's Patent) with removable conical cover and lid. (Civil and Sanitary Engineering Co., Calcutta).

galvanised iron, wood or earthen-ware (*gumla*) and so placed that nothing can get on to the floor. The receptacles should be taken out periodically, washed and cleaned, thoroughly tarred and then replaced properly. The amount of splashing is in direct proportion to the distance intervening between the receptacle and the platform, and to do away with this nuisance special *antisplash pails*—i.e. pails or receptacles with a movable cover of galvanised iron, resembling the cover of a spittoon, have been devised. By far the most popular receptacle is the earthen pan or *gumla* though it is not without drawbacks, but a metal vessel is the most suitable thing.

Cesspit.—For the storage of urine and ablution water a special receptacle or *cesspit* (generally called cesspool) should be constructed, or a vessel placed against one of the outside walls of the privy. If constructed the pit should always be of brickwork with the top portion of its walls raised a few inches above the surrounding ground level to prevent surface washings entering it. The cesspit should be protected from the rains by a cover or a roof-like arrangement. Its inner surface should be thoroughly plastered with cement so as to make it absolutely water tight, and all foul liquid should be conducted into it from the platform through an iron pipe, about two



Figs. 10 and 11. Galvanised-iron Liquid Receptacles fitted with two strong loops. (Civil and Sanitary Engineering Co., Calcutta).

inches in diameter, so that it can be easily cleaned in case of blockage. In the absence of a cesspit the liquid excreta can be received into a movable metal vessel, *e.g.*, tin canister, iron tub etc., or an earthenware pot, *i.e.*, the *gumla* and the like, but this should be placed on a concreted and cemented surface in such a way that no liquid filth falls outside. The capacity of the cesspit should be such as to hold all foul liquid for 24 hours or more without overflowing, as the sweepers, who remove this liquid filth, could not always be counted upon for daily or regular attendance. The capacity of a cesspit depends on the number of users, but as ordinarily constructed it has a capacity of about 3 cubic feet.

The steps leading to the platform should always be decent. The cost for constructing an ordinary single-seated pucca privy is about a hundred rupees.

The better class people very often construct privies on the upper storey or storeys of their houses with a drop of several feet, the result being that the floor and the lower portion of the walls of the collecting chamber get fouled by the splashing that inevitably occurs. Sometimes with the idea to improve matters a shaft or pipe is fixed connecting the orifice in the platform down to the privy pan below, but the shaft in a comparatively short time becomes quite foul by the *fæces* sticking to its sides and even gets choked up, and so very soon turns out to be a source of a serious nuisance.

Whenever a privy is wanted for each storey of the house, a drop of more than a few inches should always be avoided. This can be easily effected by placing the pan a few inches below the platform on a masonry surface supported on pillars or arches and constructing a special staircase for the *methur*. The cesspit should be constructed on the ground floor and all wash water and urine conducted into it by means of an iron pipe with the joints made absolutely watertight. A separate

tower for privies should better be constructed and connected to the main building by a covered verandah or bridge.

Privy Accommodation.—

This should always be quite in proportion to the number of users. Ordinarily in private houses one seat is required for every 6 to 8 persons, but in the case of mills, factories etc., one seat for every 30, 40 or even 50 people may be provided. In the case of boarding houses or hostels attached to schools at least one privy for every 15 to 20 boarders should be calculated upon.

Before recommending mether service for a newly built privy the sanitary officer must always inspect it in order to ascertain that it had been constructed according to sanction, if not, the application for mether should be rejected and the construction treated as an unauthorised one. In case of an existing privy mether service must not be stopped unless the premises is vacant.

Commode.—This is largely in use as a sanitary appliance for Europeans and Anglo-Indians in this country. It consists of a porcelain or enamelled pan fitted in a wooden or iron stand, the top of which forms the seat. It can be placed in the bathroom and after use the pan removed by the mether, cleaned and replaced. If proper care is taken to keep the pan clean there could be no objection to its use. A commode

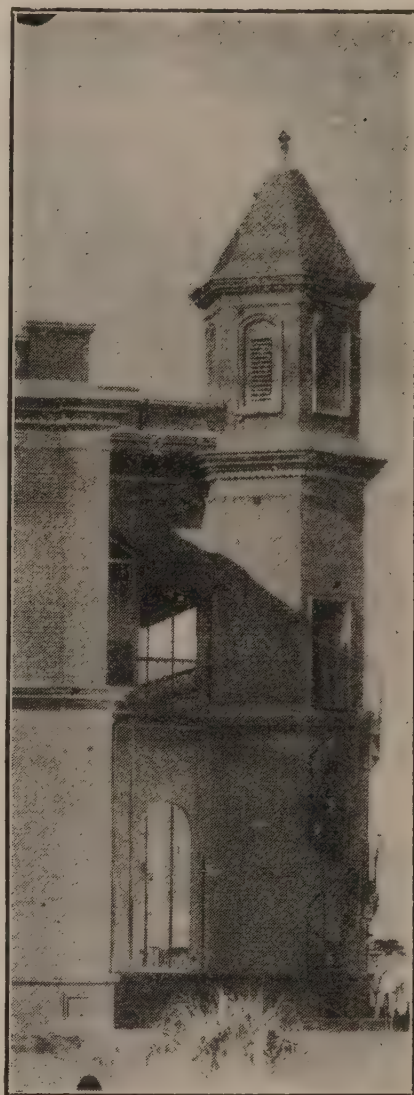


Fig. 12. Tower of Privies.

can be extemporised by cutting a suitable hole in the middle of a wooden packing-box and placing a pan underneath the opening.



Figs. 13 and 14. Commodes. (Empire Engineering Co. Ltd., Cawnpore).

In Non-Municipal towns or rural areas where no organised conservancy system exists but where plenty of waste land is always available, the inhabitants would do well to cut short and shallow trenches, each about 1 foot deep and 8 to 10 inches wide, at one end of the garden away from any tank or well and using them as latrines by squatting with each foot placed on either side of the trench, or by placing a board provided with a central opening across the trench. These *trench latrines*, as they are called, should be properly screened by bamboo matting or sacking cloth. After each visit a quantity of powdered earth should be thrown so as to sufficiently cover the excreta. When a trench is used up it should be thoroughly filled with the excavated earth and another dug near it or at a convenient site. The trenched area after about 6 months can be profitably utilised for cultivation. During fairs and *melas* such latrines are to be installed.

Residents of such rural areas or villages would do well to construct privies and subscribe among themselves to engage metherers.

Well privy.—In the villages in Bengal the houses of the well-to-do people are often provided with what are called *well privies*, which are simply pits sunk in the ground 15-20 feet or more in depth, and at the mouth of which is constructed a *pucca* platform with footrests etc., as in the case of service privies. There is hardly anything in it to recommend, but if constructed a well privy should be away from water courses to prevent the water getting contaminated from percolation of foul liquid and at some distance from the house. In such a privy a sort of septic action goes on with the result that the faeces gets liquefied—the liquid matter percolating through the bottom and the sides of the pit which are not watertight—and the gases of putrefaction escaping through the opening at the top. These privies become a source of serious nuisance during the rains when the level of the subsoil water rises. A satisfactory arrangement will be to replace these by *Aqua Privies* (which see).

PUBLIC LATRINE.

Latrines and urinals for public use should be provided at suitable places in such quarters of the town, where the owners are either too poor to fit up their houses with an adequate privy accommodation, or the houses are too small to have privies without being offensive. They should also be installed in the busy quarters of the town, in connexion with railway stations, docks, law courts, markets, *hauts* etc., in fact in any place where there is a congregation of a large number of people.

There are many forms of public latrines—Donaldson's, Horbury's and a host of others—on the market, and of these

Donaldson's separation latrine designed on the principle of the complete separation of the urine from the faeces, is the most popular, and its type No. 4—where the platform is of cast iron with a glazed stoneware deflector (size 2'-4" × 2' × 5'-6")—is almost universally used by Municipalities in Bengal and other provinces.

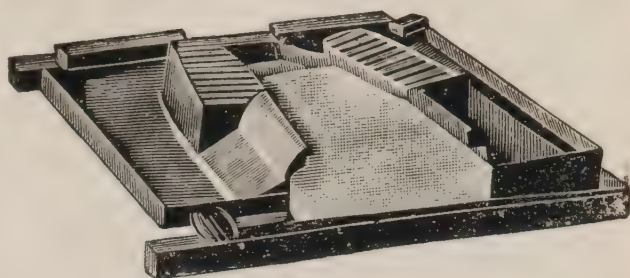


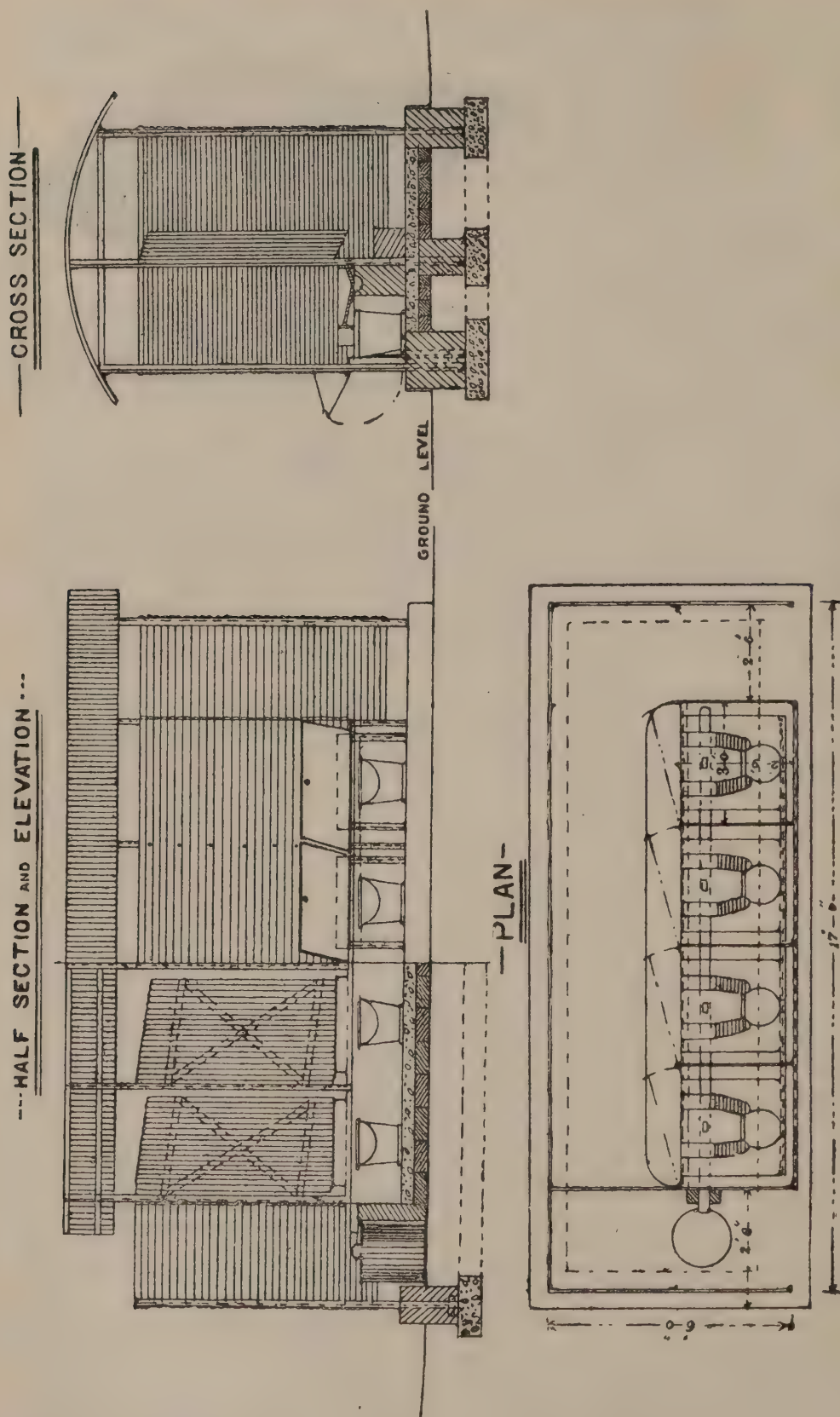
Fig. 15. Donaldson's Patent Latrine Seat No. 4 Type, C-I. with Glazed stoneware Deflector. (Civil and Sanitary Engineering Co., Calcutta.)

The latrine should be constructed on a raised plot of land, at a reasonable distance from human habitations and sources of water supply. It should be screened from public view by a belt of trees or by a wall and provided with a decent passage.

Public latrines should always be distributed according to the demand, and the number of seats in a latrine should be calculated on the number of estimated users. Such a latrine is in very great demand during the early hours of the morning (usually between 4 A.M. and 8 A.M.) and again in the evening, and provided that each user takes about 8 minutes, then one seat will serve about 7 persons in one hour or about thirty persons between 4 A.M. and 8 A.M. Working on this basis 35 seats will be required for every 1000 of the estimated users. A fair proportion of the seats (at least 2 out of every 6, *i.e.* 33 per cent.) should be kept reserved for the use of women, and for their easy identification a woman's figure might be painted on the wall with advantage. Separate passages should be provided for each sex.

There are two kinds of public latrines, viz., (1) fixed or permanent, and (2) movable or temporary.

Fixed or Permanent Latrines.—These should always be constructed on some *pucca* plinth or platform raised



Figs. 16, 17 and 18. Donaldson's Patent 4-Seated Latrine. Superstructure complete with all necessary screens, partitions, Glazed stoneware urine Drain, Galvanized-iron soil Buckets, Compartment Doors and Bucket Flap Doors. (Civil and Sanitary Engineering Co., Calcutta).

a foot or so above the ground level, and all its parts, viz., the seats, walls etc., should be made of some impervious material. The seats may be made of steel, cast iron, glazed stoneware or artificial stone, while the roof, walls and partitions of corrugated iron supported on angle-iron framing. Both the ends of the walls should remain clear of the floor and roof to ensure proper ventilation. The floor should project 18 inches on all sides from the outside of the latrine-walls.

There should always be two buckets for each seat—as a spare set is necessary to allow of the buckets when full of filth being changed to prevent nightsoil getting on to the floor. All wash water and urine should be drained into a cesspit or receptacle at one end of the latrine. Each latrine should always be placed in charge of a sweeper or methur, who should keep it quite clean and free from smells and also prevent it, and the passage leading to it, from being misused in any way. The methur should, if possible, be provided with quarters near by. A night-soil cart should be allotted for each latrine, and one having 12 or 15 seats requires two—one is to remain in attendance on the latrine while the other is taken to the trenching ground for emptying its contents consisting of both solid and liquid filth. There should be a well or a cistern for storing water to enable the methur to wash the latrine and sanitary appliances, and, if necessary, to supply the users with water for ablution. The inside walls of each latrine should be periodically painted to a height of about three feet with tar, which is a good preservative as well as a deodoriser, and washed at least once a day with some disinfectant, e.g., phenyle or cyllin solution. It is better to have a number of small latrines conveniently distributed throughout the town rather than a few bigger ones placed at long intervals. The old type of large masonry latrines should be replaced by the modern sheet iron ones which are quite clean and sanitary and more liked by the public.

Temporary or Movable Latrines.—These are installed when the permanent ones are not required as during fairs or festivals, or in connexion with segregation camps, etc.

These latrines should be portable, simple in construction so that they can easily be set up by unskilled labour, and complete with receptacles, base plates, bolts and nuts. There need not be any pucca floor, and the receptacles—separate for solid and liquid dejecta—are simply placed on the ground. The latrine should be removed to a different site as soon as the ground on which it stands becomes sodden ; ordinarily

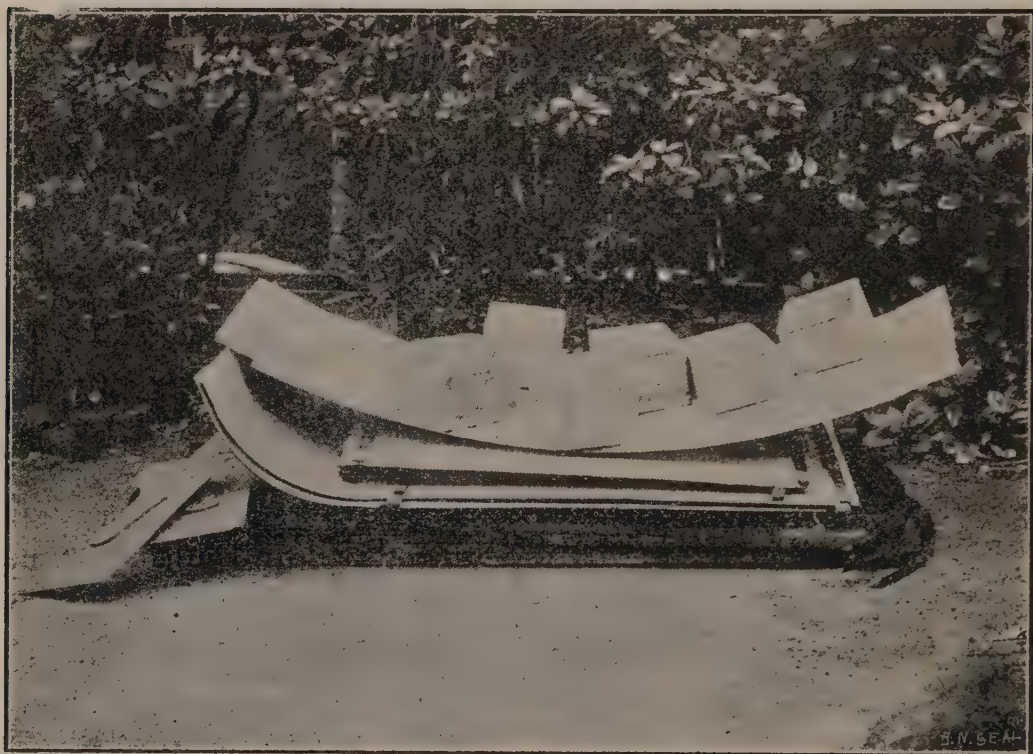


Fig. 19. Patent Portable Latrine dismantled for Storage or Transport. Designed for all conditions where a latrine is temporarily required. (Civil and Sanitary Engineering Co., Calcutta).

this becomes necessary once in a month or six weeks during wet weather, and once in about three months during dry weather. After the removal of the latrine the site should be dug up to a depth of about a foot or more and left exposed to the sun and air for some time. It is better to remove

this polluted earth and have the site brought up to its proper level with fresh clean earth.

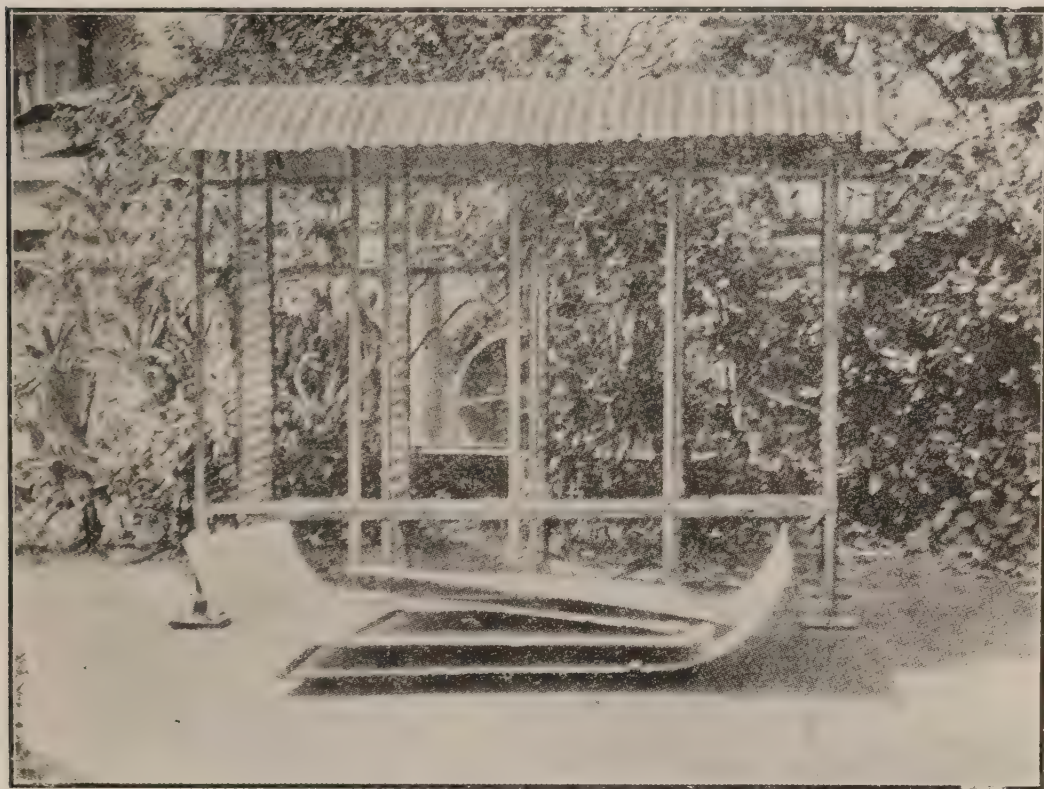


Fig. 20. Patent Portable Latrine. Inside view with screens removed. (Civil and Sanitary Engineering Co., Calcutta).

A temporary latrine should always be fixed on a raised plot not subject to flooding and have other arrangements similar to that of a permanent latrine. A latrine if properly looked after and used should not foul the ground, but owing to the uncleanly habits of the lower class Indians, who usually resort to these, it is practically impossible to prevent the pollution of the soil. For each such latrine two sites should be provided alongside of each other and when the plot first occupied becomes offensive the latrine should be removed to the other site.

Urinals.—These should also be properly lighted and ventilated and the materials chosen for their construction should be of a non-absorbent character. These conveniences

should be so located as not to prove a nuisance or offensive to decency, and provided with water-tight receptacles which



Fig. 21. Donaldson's No. 1 Type Glazed stoneware Urinal Seat. (Civil and Sanitary Engineering Co., Calcutta).

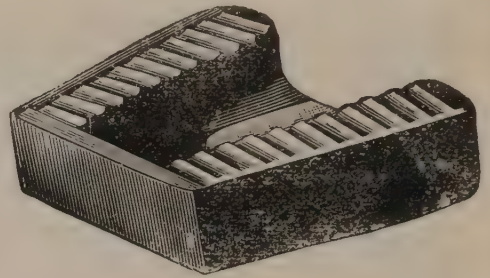


Fig. 22. Donaldson's No. 2 Type Glazed stoneware Urinal Seat. (Civil and Engineering Co., Calcutta).

should be emptied as often as necessary. The floor of the urinal should have a slope towards the outlet and provided with footrests. The superstructure is best made of corrugated

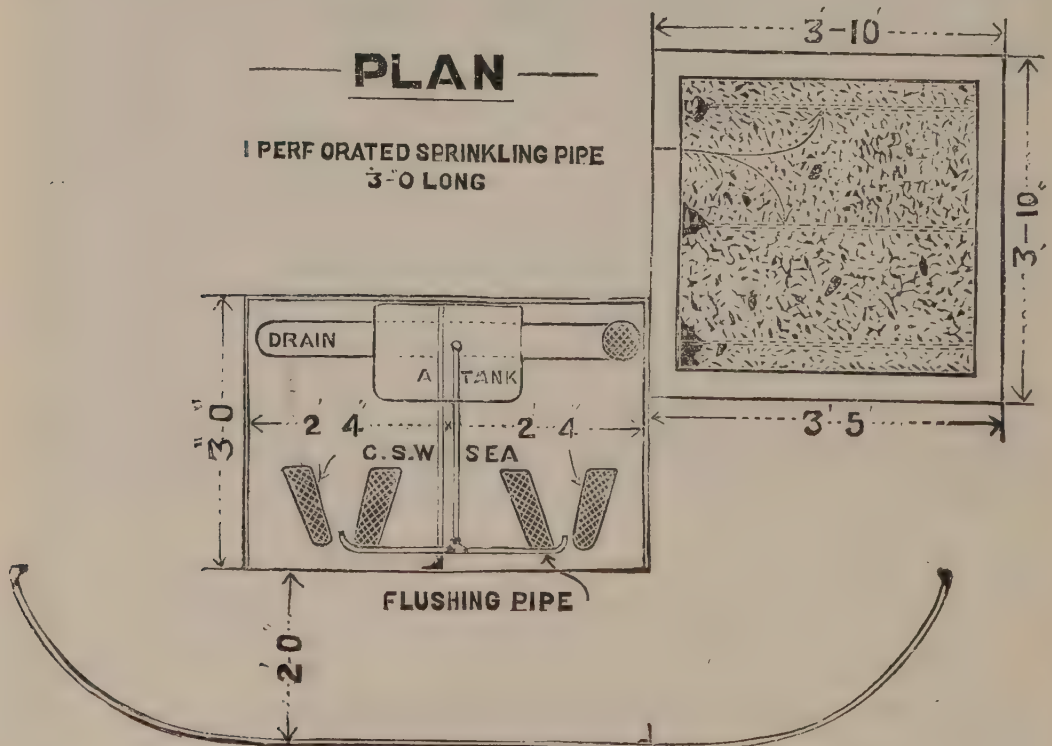


Fig. 23. Urinal with Donaldson's No. 2 Glazed stoneware seats and Galvanised-iron sprinkling Pipes for Nitrifying Bed or Tank which is made of Masonry. (Civil and Sanitary Engineering Co., Calcutta).

and angular iron similar to the latrine superstructure. The receptacle should be placed outside and may be of galvanised iron, and painted periodically.

In connection with public urinals a water-tight masonry nitrifying bed, having a dimension of $3' \times 3' \times 3'$ and filled up

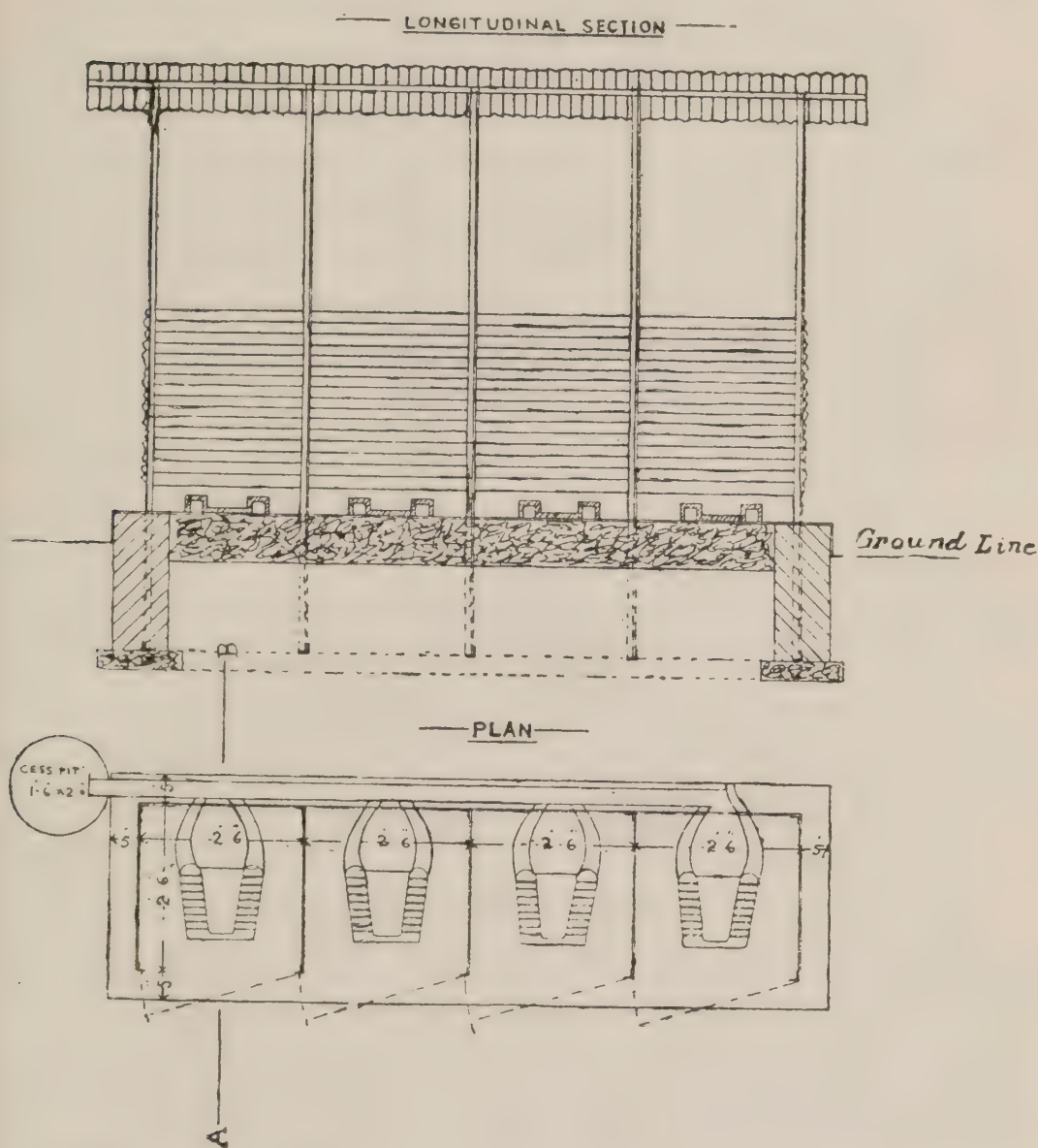


Fig. 24. Donaldson's Patent Urinal fitted with No. 2 Type Seat (Civil and Sanitary Engineering Co., Calcutta).

with graded *khoa* or vitrified bricks, may be constructed for the purification of the urine. The floor should be sloped towards

the outlet to enable the filtered liquids to flow into existing drains. In places where no proper arrangement for the removal of the cesspit contents exists, a similar arrangement

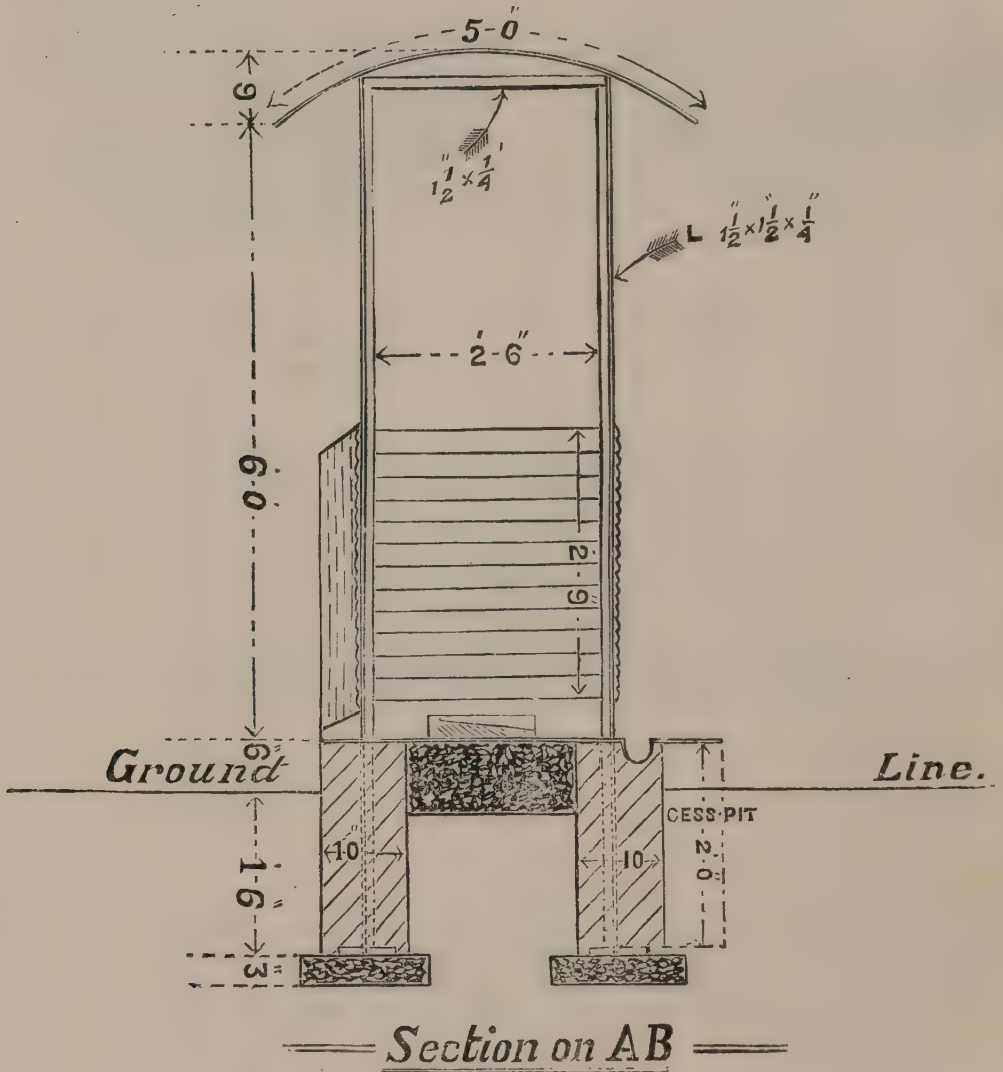


Fig. 25. Section of Donaldson's Patent Urinal, fitted with No. 2 Type Seat. (Civil and Sanitary Engineering Co., Calcutta).

might with advantage be made in connexion with the privies for the purification of liquid filth.

CHAPTER III

COLLECTION OF NIGHTSOIL

The system that is in vogue in the Municipal towns in India consists in employing a regularly organised corps of scavengers—methers, bhangis or halalkhores as they are variously called—and the division of the town into several blocks or sections for convenience of work and supervision. To enable the sweepers to do their work properly not more than 30 to 40 privies should be allotted to each, if the houses are quite close together ; but if they are scattered—so that the mether has to travel long distances to collect nightsoil—the number of privies apportioned to each must be necessarily less, it may be 15, 20 or 25 according to the distances intervening.

The cleansing operation in Bengal usually consists in scooping out the night-soil from the privy pan or *gumla* by means of a shallow earthen-ware vessel and then collecting it in tarred wooden or iron buckets or pails which are wider at the bottom than at the top to ensure strength and provided with tight-fitting lids. In the up-country towns the night-soil is usually collected dry after mixing it with ashes or dry earth and then removed in baskets which have their inner surface thoroughly coated with clay or cow-dung. A serious temporary nuisance is created during the emptying of the privy pans and sometimes after as the receptacles always present an increased foul surface to give off effluvium which is usually of an extremely noxious nature. The collection and removal of night-soil are in some places effected by contract either wholly or partially.

The *number of methers* to be employed is in direct ratio to the number of privies, and the distance that each sweeper has to travel in the execution of his work.

The methers should be divided into batches of eight or ten or at most a dozen of them, and each batch should be under the charge of a Jamader or Headman who should be held directly responsible to the Conservancy Inspector for the proper supervision of his beat. Each Jamader can well supervise the cleansing of some 300 to 400 privies or, in other words, the working of 10 or 12 methers. The methers for public latrines should be a separate lot and placed under a separate Jamader. The collection of night-soil should be done early in the morning of every day and, if possible, once again in the afternoon. The Municipal Commissioners are vested with the powers (*vide* section 187 of Act III 1884 B. C.) to prescribe hours for the collection of filth with a minimum of nuisance.

There are some who advocate collection of excreta at night but the reasons against this have been summed up by Mr. H. T. S. Forrest, I. C. S., as follows :—

(1) In most Indian houses the privies are in the back yard and can only be reached by way of the front door. A householder naturally objects to leaving his front door open all night.

(2) Sweepers enjoy only a poor reputation for honesty and householders object to their being given authority to be on their premises at night.

(3) Sweepers themselves strongly object to night work and will not work except in gangs. They are afraid of snakes, scorpions and ghosts and do not run the risk of being taken for thieves and knocked on the head.

(4) When they work in the dark, proper supervision is impossible and they cannot be prevented from emptying their buckets into drains and tanks.

In order to work in the dark it is necessary that each scavenger should carry a light and this would naturally hamper his work which requires the use of both hands.

The privy pans should be completely emptied as any accumulation of night-soil would be productive of serious nuisance and would also encourage the breeding of flies which are well-known as carriers of diseases. The inspecting officer must personally examine some of the privies in order to satisfy himself that all night-soil has been efficiently removed, instead of depending, as is being ordinarily done, on the report of the Jamader. The methers are very irresponsible, careless and irregular in their work and any neglect on their part should be promptly and firmly dealt with. Any night-soil found on the streets must also be removed by the mether of the beat.

Duties of methers.—No mether shall throw, deposit or discharge any night-soil and sullage into any river, tank, well, *khal* or canal, drain, openland, jungly area etc. No mether carrying sewage through the streets shall loiter or deposit any vessel containing or intended to contain night-soil by the side of any public street, nor should he transfer the contents of the pail into a cart while it is passing through the street. They must clean all nightsoil buckets, sullage and nightsoil carts before going off duty. Each mether should be provided after the morning muster with a ticket which should be collected by the Jamader either at the pail or nightsoil transfer depôt or at the trenching ground, wherever he will be required to go, and afterwards made over to the inspecting officer. He should also bring any defects in a privy to the notice of the Jamader who would, in turn, report the fact to the sanitary officer for necessary action.

CHAPTER IV

REMOVAL OF NIGHTSOIL

Quantity of Solid Excreta to be Removed.—A healthy adult Indian, who is mostly a vegetarian, passes about 16 ounces of solid excreta per day as against 4 or 5 ounces passed by a fullgrown European, who is principally a meat-eater; women and children pass less. So in a mixed population consisting of persons of all ages, sexes and communities the amount of bowel excretion requiring removal may be adopted on an average of 12 ounces or 6 chittaks per head per day. This works out at the rate of about one gallon (5 seers) for every 13 of the population. A nightsoil cart having a capacity to hold 110 gallons would, therefore, remove the excreta of about 1,400 persons or the contents of about 275 privies, as the average number of persons inhabiting a house is estimated at five per house; and a town having a population of, say, 15,000 would therefore require 11 nightsoil carts—each making one trip a day, or 6 if two trips are made daily.

As for the urine an adult Indian voids as much as a European does, i. e., about 50 fluid ounces a day. But the whole of this quantity is not required to be collected as the ordinary Indian houses are not provided with any sort of urinal or receptacle for the deposit of urine. An Indian generally uses the house drain, if any, or the secluded or jungly area in the compound or near his house, or the road flank or drain as urinal and it is also not uncommon to find people polluting the water of tank direct. Such a practice, of course, should be discouraged. An adult Indian usually visits the privy

twice a day and at each time voids about 12 ounces of urine, whereas each child passes a lesser quantity. Therefore for practical purposes 20 ounces of urine per head in a mixed population per day may be estimated as the amount requiring removal.

Again the contents of the cesspit increase in bulk considerably by the addition of ablution water and water used for washing the platform. The Hindoos generally use a larger quantity of water, about a seer (*i.e.* 32 ounces) each time or 64 ounces a day, for ablution than the mahomedans, while children up to the age of about 7 or 8 do not usually wash themselves in the privy. Moreover in the mofussil or country districts people usually prefer tanks, rivers or streams for cleaning themselves. The Europeans and the Anglo-Indians, whose number is practically negligible in the mofussil, do not use water for ablution like the Indians. So taking all these factors into consideration 40 ounces of ablution water per head in a mixed population is not too much to base a calculation upon.

As for the quantity of *privy washing* finding its way to the cesspit it must be noted that it is not usual to wash the platforms daily. The better class people usually get their privies washed almost daily with plenty of water, whereas with the lower class—with whom cleanliness is ordinarily at a discount—such cleansings are few and far between. On an average each privy platform may be taken to be washed twice a week and at each wash about two gallons (or 10 seers) of water used. This works out at the rate of about 3 seers, say 100 ounces, of water used for each privy per day, and assuming that each house is occupied on an average by 5 persons, then about 20 ounces of privy washing per head per diem is to be calculated upon for removal.

Hence the total amount of sullage or cesspit contents that

requires to be removed per head of the population daily may be estimated as follows :—

Urine	20 ounces.
Ablution water . . .	40 ounces.
Privy washing	20 ounces.

Total ... 80 ounces.

This total is nearly 7 times as much as that of the solid excreta passed by a man daily. Hence the number of carts etc., that would be required for removing this liquid filth should be about seven times more than that required for transporting night-soil. But the cost for maintaining such a big establishment is practically prohibitive for ordinary municipal towns, and the inevitable consequence is that the sullage, which is a highly putrefactive liquid and decomposes very rapidly on account of the organic materials it contains, overflows on to the roads forming puddles and helps not only to breed mosquitoes but also to pollute the air, soil and the neighbouring water-courses through percolation. This foul liquid can only be satisfactorily got rid of if there is a complete system of masonry drains.

Removal of Nightsoil.—After collecting nightsoil the *methers* carry the pails, unless otherwise directed, at once to the nightsoil or pail depots for transferring the contents to the nightsoil carts, which are to remain in waiting there. In some places the pails are carried by the sweepers directly to the trenching ground ; this means a reduction in the number of carts, and carters and a proportionate saving of the Municipal finance. Each female scavenger or *methrani* carries a pail on her head, while the *mether* or the male sweeper usually carries two pails slung on either side of a bamboo pole. In parts of Calcutta, Benares, Cawnpur etc., which have not yet been sewered, the pails are taken to the nearest

depots connected with the sewers (underground drains) well-flushed and trapped, and there the nightsoil is discharged. In some towns again, *e.g.*, Dacca, the excreta is first collected in tin canisters or buckets and soon after transferred to nightsoil railway tubs fitted into bullock-frame cart, which either moves along with the mether or is kept in waiting in some solitary place or lane nearby. Later on when the collection of nightsoil is finished the carts are taken to the depots where the tubs are transferred by means of a crane to tramway frames for their removal to the trenching ground. The carters should always accompany the carts, and if these are drawn by buffaloes they should take special care to prevent them from running into the roadside drains or pools as they are very apt to do so during the hot weather. The filth is in some places removed by hand carts direct to the trenching ground for reducing the nuisance caused by handling at the depots.

Nightsoil transfer or Pail Depots.—These are special sites or selected places where the transfer of nightsoil from the pails or buckets to the nightsoil carts is carried out. These should be conveniently located, and one for each beat or a couple of beats at the most is to be recommended, or else much time would be uselessly wasted in travelling long distances. The depots should be in isolated places in order to spare the inhabitants of the locality the inconvenience and discomfort that they must feel during the operations when the nuisance produced is simply horrible. The floor should be properly paved and the site screened either by high masonry walls or corrugated iron sheets, which should be tarred frequently. The work of transferring nightsoil must be completed every morning within a specified period, preferably by 7 A.M. or 8 A.M., after which all the pails and the depots should be thoroughly cleaned, and all washings removed by the carts and not allowed to be thrown into any jungly land, drain,

or garden. The depot should be under the charge of the Jamader of the beat or a special man who would look to the work and also to the cleanliness of the place.

Before the loaded carts leave the nightsoil depot for the trenching ground their lids should be properly sealed with some moist earth in order to prevent the escape of foul gases.

The nightsoil carts drawn either by bullocks or buffaloes move through the streets very slowly much to the annoyance and disgust of the residents and passersby. They move generally at the rate of about a couple of miles per hour, and in order to minimise nuisance the carts should be made to pass through the lanes and bye-lanes under strict watch to prevent the carters from tipping the carts into any jungly area. The carts should not be leaky and unnecessarily detained at the trenching ground. After unloading the interior of the carts should be thoroughly washed clean with water.

In some towns, *e.g.* Howrah, the nightsoil is carried in special railway wagons drawn by steam engine. The trucks should only be filled with nightsoil up to about two-thirds of their depth to prevent splashing during transit by their jolting. The lid should always be firmly and properly fixed. This is no doubt a quicker and better way of despatching nightsoil if the place for its final disposal is at some distance.

Receptacle System of Nightsoil Removal.—This consists in removing nightsoil in special airtight and non-absorbent receptacles and is considered to be very economical and sanitary. The receptacles are made of galvanised iron, sealed at the depots after being filled with nightsoil and then taken to the trenching ground in lorries which should be strongly made of wood and at the same time light and easy to draw, or in light railway trucks inoffensively. The carrying capacity of a lorry varies, but a big one carries 24 receptacles—about 220 gallons, *i.e.*, more than double the quantity that a

nightsoil cart holds. Two men and a pair of bullocks are necessary for each big cart ; these men should also empty the receptacles in the trenches and afterwards wash them

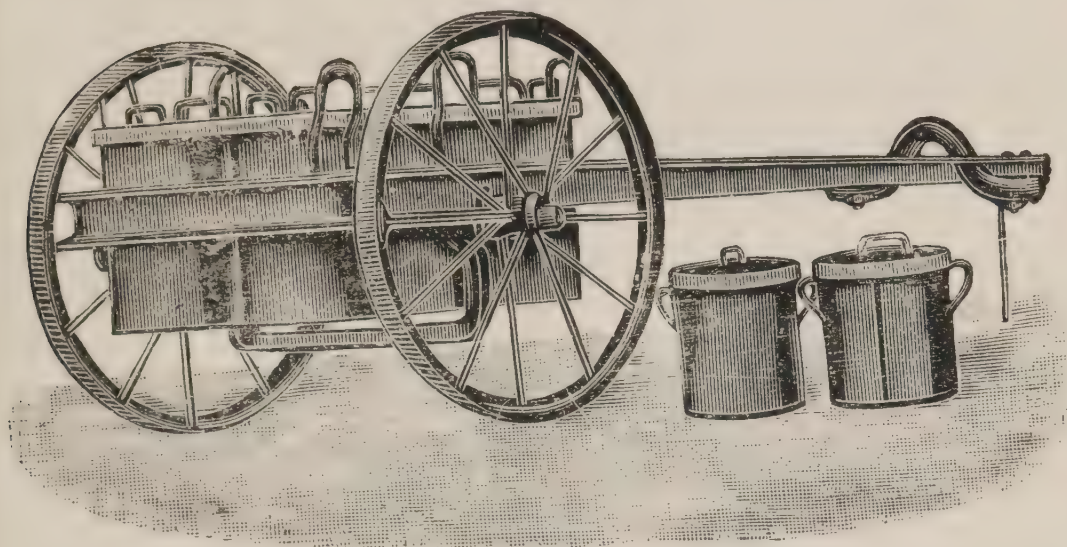


Fig. 26. Receptacle cart made of wrought-iron to carry six receptacles. Drawn by a single bullock and fitted with wood or iron wheels. (Civil and Sanitary Engineering Co., Calcutta.)

quite clean. This method of removal of nightsoil has proved satisfactory.

The system of collection that seems to guard best against the production of nuisance and spread of infection is that adopted in Florida, U. S. A., where the pails are standardised and a large number of spare ones provided, so that when a collecting van leaves the depot it is loaded with clean pails that have been disinfected. When the sweeper calls at a house he takes one of these pails which he leaves in place of the pail he removes and puts on the van, no attempt being made to empty the pail till it reaches the depot. By this means the contents of the pail are not disseminated so as to pollute the air of the street, while the cleansing and disinfecting of the pails at the depot ensure a clean pail remaining in or near the house.

The system of removal of all refuse—nightsoil and rubbish—by light railways has been found most expeditious, effectual and economical and is recommended to all big Municipalities where a large quantity of filth has to be conveyed daily a long distance for disposal. Of course for a short run bullocks and buffaloes are to be preferred, but if the distance is great, say more than 2 or 3 miles, locomotives will be found to be expedient and economical.

CHAPTER V

CONSERVANCY APPLIANCES

The following are the principal conservancy appliances :—

Pails.—The pails that are in use in most of the Municipal towns are made of wood with bottoms wider than the top to ensure firmness. The external measurement of a pail is ordinarily $16'' \times 16'' \times 11''$; it has a capacity for holding about one cubic foot or 6 gallons more or less. It should be properly tarred (both inside and outside) so as to render it thoroughly non-absorbent, and the tarring is to be repeated once every month or oftener. Each tarring costs about an anna. A pail costs about Rs. 1-4-0 and lasts some six months. The lid or cover should fit in properly.

The best pails are those made of galvanised iron. They



Fig. 27. Galvanised-iron Nightsoil Receptacles which can be sealed hermetically with a few handfuls of earth or a little water. (Civil and Sanitary Engineering Co, Calcutta.)

are costly at the outset but cheaper in the long run and one lasts about three years.

Nightsoil Carts.—Carts of different types and capacities are available, but one having a pearshaped revolving body capable of holding 110 gallons is to be preferred to others. Cylindrical or barrelshaped carts having a sill at the bottom or back and guarded by a valve or plug are inferior to the former, as the valve leaks in time and the plug becomes loose and not infrequently comes off during the movements of the cart.

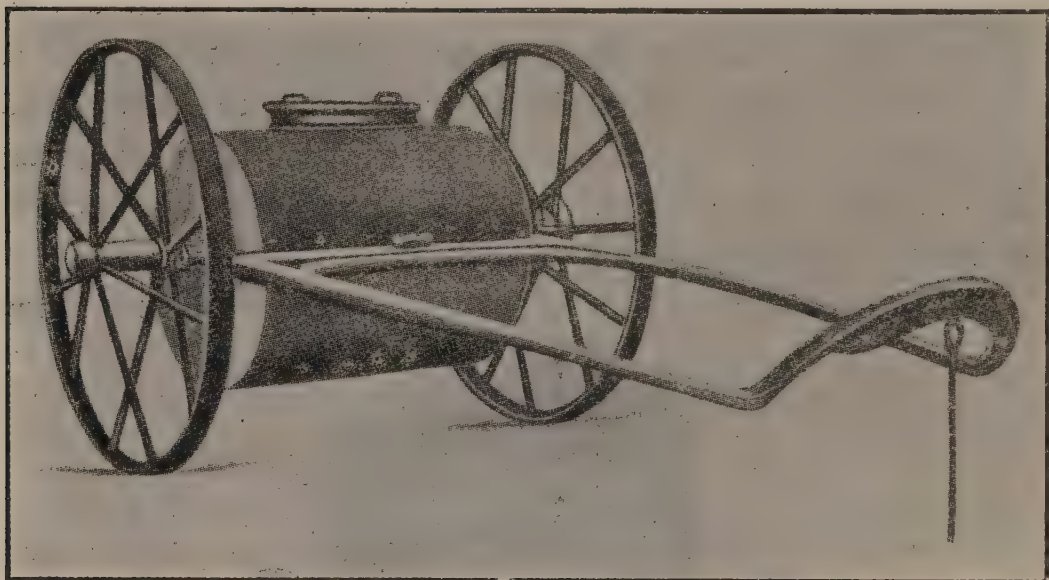


Fig. 28. Night-soil and Urine Cart fitted with Iron wheels. The whole cart is made of Steel, with the exception of the wood pad for the yoke, the axles are strongly rivetted to the body with the addition of plates to prevent buckling. Fitted with double lid, it empties easily by revolving on the axles. (Civil and Sanitary Engineering Co., Calcutta.)

The carts that are good for general use should have their bodies made of steel with the exception of a wood pad for the yoke, with wheels of iron, as the spokes of the wood wheels shrink and become shaky during dry weather. The body should have its opening on the top covered with double lid—one inside the other, the inner lid being quite flat and the outer one provided with a rim which fits into a groove all round the opening. Foul gases are prevented from escaping by putting a little water in the groove. Both the lids should be provided

with handles, and to seal up the opening thoroughly some moist earth must be put in the space between the lids. The yoke should be perfectly smooth to prevent the necks of the animals from being galled or injured, and any roughness removed by rubbing with a piece of sandpaper or by the sharp edge of a broken piece of glass, etc.

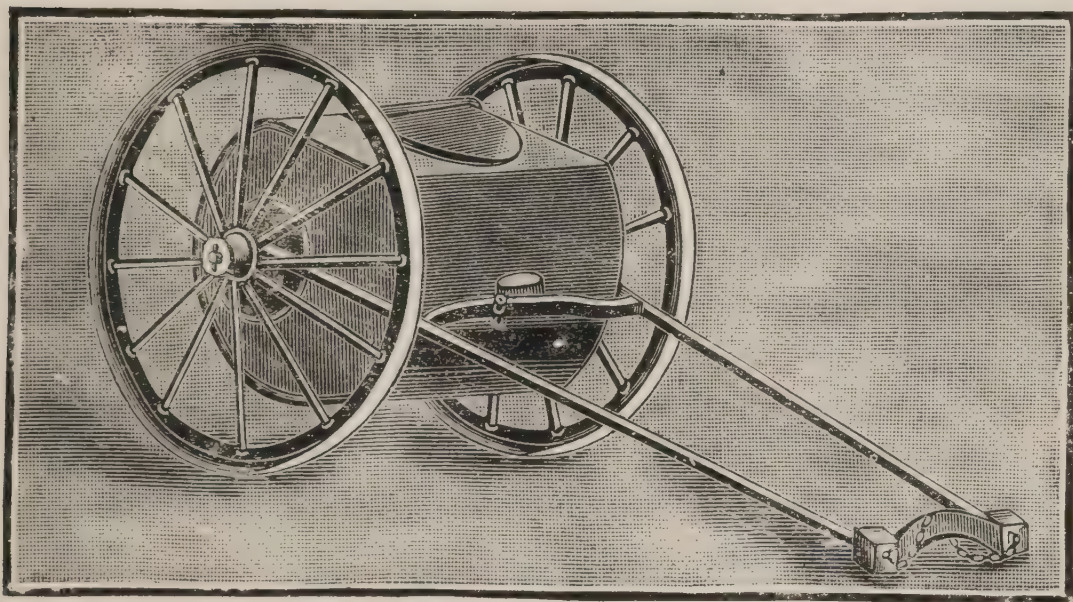


Fig. 29. Revolving Body Night-soil Cart similar to Fig. 28, with flat top and Tice's Patent Air-tight Lid, Solid Axle. (Civil and Sanitary Engineering Co., Calcutta.)

The following is the description of the nightsoil (and also of urine and *goala busti* carts for removing filth from cattle sheds or cow-houses) carts that are in use in most of the Municipalities in Bengal :—

The capacity is 110 gallons for a single buffalo with double lid or cover, each of which is fitted with two handles.

The body of the cart is made of sheet steel $\frac{1}{4}$ " in thickness and the side plates of $\frac{1}{4}$ " in thickness fitted with angle iron with necessary rivets. (It empties easily by revolving on the axles).

The buffer axle is of $\frac{1}{2}$ " thick mild steel plates 1 foot in diameter to be fixed with six $\frac{1}{2}$ " nuts and bolts with an inside

plate of $\frac{1}{4}$ " in thickness of the same diameter. The diameter of the axle is slanting from 2" to $1\frac{1}{2}$ ". (The axles are strongly rivetted to the body with the addition of plates to prevent buckling.)

The axle washer is of $\frac{1}{8}$ " in thickness and $8\frac{1}{2}$ " in diameter.

The shafts are made of 1" diameter rod iron 8 feet in length.

The stay is made of angle iron $1\frac{1}{2}$ " \times $1\frac{1}{2}$ " \times $\frac{1}{4}$ " fitted and fixed with the body of the carts.

The crosspiece is made of flat iron $1\frac{3}{4}$ " \times $\frac{1}{2}$ " with two catch pins fitted and fixed on it.

The wheel is made 4'-6" in diameter of seasoned *sissoo* wood; the nave is made of seasoned *sissoo* wood $9\frac{1}{2}$ " long and $9\frac{1}{2}$ " diameter fitted and fixed with $1\frac{1}{4}$ " \times $1\frac{1}{4}$ " tyres on both ends, and with a cast iron axle box $\frac{3}{4}$ " thick and $9\frac{1}{2}$ " long for 2" diameter axle.

Spokes are made of seasoned *soondry* wood $2\frac{1}{4}$ " diameter and 16 in number fixed in zigzag way.

Felloes are made of seasoned *sissoo* wood $2\frac{3}{4}$ " \times $2\frac{1}{2}$ " and 8 in number.

Yoke is made round of *soondry* wood with plates, fixed on both ends and top.

Tyre is made of flat bar iron $\frac{1}{2}$ " \times $2\frac{1}{4}$ " properly fitted and fixed with $\frac{1}{2}$ " bolts and nuts on each felloe.

Carts of the above description can be had for about Rs. 130 or Rs. 140/- and with regular painting and repairs, which costs about Rs. 30/- yearly, last for about three years. The average charge for greasing is Rs. 6/- a year and for painting, which is done at least once a month with about a seer of tar each time, Rs. 3/-; the coating of tar prevents the acids produced by the fermenting mass of fœces from eating away the metal body. Before painting, the cavity should be thoroughly cleaned by washing and then burning some straw inside.

CHAPTER VI

DISPOSAL OF NIGHTSOIL

The disposal of nightsoil in such a manner as to secure it from being no longer a nuisance or menace to public health is rather a difficult problem, but all excrementitious matters are usually disposed of either by (1) trenching, *i.e.*, burying in the ground, or (2) by incineration or burning. As to the merit of the various systems of sewage disposal the Education Department of the Government of India in a resolution dated the 23rd of May 1914, observed as follows :—

“Whether incineration or shallow trenching or either of these methods of conservancy combined with water carriage system is the best in any particular case will depend very largely on local conditions and customs. With the exception of drainage and sewerage systems, water carriage of all nightsoil, with ultimate disposal on sewage farms, should give the best result. In the majority of towns, however, it will be long before this is generally practicable and the choice rests between incineration and trenching. Of the two methods incineration is safer, and on this account, if conditions permit, is preferable. Trenching is often thought to be more economical ; but the profit obtainable from trenching or pitting of nightsoil and sale of the poudrette disappear, or are largely reduced, when the expense of carriage and of supervision is taken into account. The material consideration in all cases is that the removal and disposal should be prompt.”

The cremation of human excrement requires fuel and if not properly carried out gives off offensive smell, hence the primitive and effective method of committing it to earth (or trenching) is resorted to. With many animals this is a natural instinct—particularly so among the carnivora in which the matters are nitrogenous and therefore highly offensive.

Trenching or burying of nightsoil in shallow trenches is universally practised in India. This system works on the principle that dry earth is the natural deodorizer of excremental matter and that the superficial layers of the soil, which are teeming with nitrifying organisms, change the complex nitrogenous organic matters into nitrites, which finally by taking up oxygen from the air become converted into nitrates ; these when dissolved in water, are easily sucked up by the roots of plants and trees and act as food for them. These nitrifying bacteria, which play such an important part in the purification of sewage, diminish in number with the depth of the soil where they do not get enough oxygen (air) and animal and vegetable matter to live on, and finally at a depth of about 5 or 6 feet from the surface they appear to die out or are very few in number. Consequently shallow trenching is always to be preferred to deep trenching which retards considerably the process of nitrification.

The *trenching ground* should always be a selected plot of land, but an ideal site is very difficult to obtain, especially in Lower Bengal where it is too often a despair for the Sanitary Officers. It should preferably be on the leeward side of the town at a distance of at least a quarter of a mile (400 or 500 yards) from any inhabited quarter or water course. The site should be high and dry and not subject to flooding. The soil should be of a light porous nature so that all moisture is rapidly absorbed ; stiff tenacious clays, peaty or boggy ground and coarse gravel with hard conglomerated layers are most unsatisfactory. It is a good plan to have always a thick row of trees, such as a mango grove, between the trenching ground and the town to prevent the latter from being invaded by infective dust and flies as far as possible.

Not infrequently it happens that suitable land cannot be procured within a reasonable distance of the town limits. In such a case a low-lying or flat plot of land can be acquired and

improved or raised artificially by earth obtained by excavating tanks, which are always required for washing buckets and carts and for purposes of irrigation when any trenched area is brought under cultivation. Moreover these tanks also yield a good income when leased out for fish culture. An unsuitable plot of land, when trenched over and over again improves much in quality. All high lying plots should always be kept reserved for use during the rains.

For the proper *management of trenching grounds* in Bengal the following instructions, which give everything in a nutshell, have been issued by the Sanitary Commissioner :—

“The objects of trenching are to dispose of nightsoil with the least possible offence as regards smell and to prevent the breeding of flies which are great carriers of disease. It has been found by experience that deep trenching is most objectionable from a sanitary point of view, as in this case the disintegration of nightsoil is too long delayed, and the ground does not become properly purified by cultivation, as the roots of the crops grown do not penetrate deep into the soil.

Further if larger proportions of nightsoil than those recommended below are trenched, a much longer period must elapse before cultivation can be commenced, and moreover the strength of the manure being very great, crops are liable to be withered up from the heat given out. A shallow method of trenching, which is by far the best, should therefore be carried out properly. If this method is employed, the ground will be ready for cultivation within a few months. The trenches for this purpose should be either one or two feet in breadth and one foot deep ; nightsoil to the depth of three inches only should be allowed to be put into them, and should then be covered with the excavated earth. The total length of the trenches can be easily calculated if the total amount of sewage to be disposed of, is ascertained. The exact capacity for each barrel or cart should be measured. Thus for every 25 gallons

of sewage a trench two feet broad and one foot deep, filled to the extent of three inches or one-fourth foot of sewage should be 8 feet long, as $2' \times \frac{1}{4}' \times 8' = 4$ cubic feet or 25 gallons. The trenching ground should be divided into three plots, so that every plot may be trenched once every three years. The remaining two plots must be kept under cultivation while the other is being used for trenching. Crops such as mustard, tobacco, makai, castor oil and other dry crops are best suited for these richly manured lands. Cultivation is a vital element in the success of a trenching ground, as without this method of purification the ground becomes sewage-sick and unfit for retrenching. Crops grown on these lands prove so valuable that once the system is properly introduced ten times the ordinary rent can be obtained from them."

Calculating on the basis given above (*i. e.*, 8 feet by 2 feet for a trench) 16 sq. ft. of land are required for trenching 25 gallons of sewage ; the area of land that would therefore be necessary for one cartload or 110 gallons of nightsoil (or for trenching the excrement of some 1400 persons) would be about 70 sq. ft. ($35' \times 2'$). So if a town has a population of 15,000 persons then the daily area required for trenching the nightsoil of the whole population will be about 750 sq. ft., *i. e.* to say just a trifle over a cottah (720 sq. ft. = 1 cottah), or a bigah and a half a month (20 cottahs = 1 Bigha), or about 19 bighas (6 acres) annually exclusive of passages and tanks or wells. Hence the total area of the trenching ground would be three times as much or 57 bighas for 3 years' trenching, and inclusive of roads etc., no less than 60 bighas. This works out at the rate of one and a third ($1\frac{1}{3}$) bighas per 1000 people per annum or 4 bighas for 3 years. But such an extensive plot may not always be available, and so the best thing to do would be to make the trenches 18 inches deep and fill a third of their depth (*i. e.* 6 inches) with nightsoil, so that for the same area double the quantity of excreta could be

efficiently trenched (i.e. $2' \times \frac{1}{2}' \times 8' = 8$ cubic feet or 50 gallons). Hence 30 bighas (nearly 10 acres) will be the total area of the trenching ground instead of 60 as calculated above for a town having a population of 15,000.

Experiments carried out by the writer led him to conclude that the nitrifying organisms in the soil multiply enormously after the application of excreta, which being a substance of an organic nature, no doubt, act as their food and as a result the soil very much improves in quality. This multiplication of the bacteria causes the nightsoil, after its application to the earth, to be disintegrated sooner in a 'ripe' soil (i. e. soil which has been repeatedly trenched) than is the case with a 'virgin' soil where the bacteria could not so develop for want of sufficient food. It had been found that when the nightsoil had been deposited properly in a ripe soil it took four to five months for it to be properly disintegrated and converted into a sort of loose black earth without any trace or smell of faecal matter, whereas it took about two or three months more to acquire this character when embedded in a virgin soil. He further holds that a repeatedly trenched soil does not become what is popularly called "sewage-sick", because of the fact that the products of disintegration, nitrates etc, are removed by the percolating rain water leaving the ground quite fresh and fit with its increased number of bacteria for the further reception of excrement, while the gases escape into the air. It would therefore be seen that the cultivation of a trenched area is not an absolute necessity, except from financial considerations. In short the writers' theory is that by repeated trenching a soil gets so highly improved from the growth and multiplication of the nitrifying organisms that it can be retrenched every few months (6-9 months) with no less, if not more, satisfactory results than that obtained by trenching once in three years as has been the practice hitherto. This means a very great reduction in the

initial cost of acquiring and laying out a trenching ground as only a comparatively small plot of land would be required.

The trenches should be dug in straight parallel lines about two and a half feet apart from one another, and the intervening spaces used later on. The trenches may be made of any length but for working purposes they are usually made 30 to 40 feet long with a gentle slope towards the end to allow of an easy distribution of nightsoil when dropped into them. A trenching ground cooly (digger or bailder) can cut a trench $35' \times 2' \times 1\frac{1}{2}'$ or 105 c.ft. in capacity, break the lumps of the excavated earth and cover the nightsoil with it during his usual hours of working (5 to 11) in the morning without his energies being taxed unduly. Each such trench would hold $35' \times 2' \times 1\frac{1}{2}'$ or 35 c. ft. or about 220 gallons (2 cartloads) of nightsoil which is equivalent to the sewage of about 2800 persons. Hence about 6 coolies or diggers will be necessary for a population of 15,000. The pay of a digger is about Rs. 19/- a month.

The trenches should be covered up completely with the excavated earth immediately after the deposit of the filth in them in order to allow the flies little opportunities to breed, and for this reason it is advisable to have one trench for each cartload of nightsoil. If the trench is big enough to hold the contents of more than one cart then the unloading of the carts should be deferred until the requisite number of them turns up. The cart should at one end of the trench be so adjusted that when its body is turned over all the sewage is thrown directly into the trench without fouling the surface of the ground. The earth at the bottom of the trenches, especially if they are dug in a hard soil, should be loosened so that all moisture is sucked in readily.

The earth should always be broken as finely as possible before being put back into the trenches, or else the big lumps would simply sink to the bottom causing the nightsoil to

come right up to the surface of the ground. The filling up of the trenches should be commenced from the end where the nightsoil had been dropped and gradually pushed on to the other in order to get the filth distributed properly. If the directions for trenching are strictly followed the nightsoil in about six months' time is converted into a black and odourless mass, and the land can then be ploughed up and brought under cultivation. This black earth is in some parts of India bought by the cultivators at a good price as it has a very high fertilizing power. In addition to the crops mentioned before, cabbages, cauliflowers, jute, sugarcane, gourds, brinjals, guinea and *dhooob* grasses grow very luxuriantly on trenching grounds.

The trenching ground should be provided with pucca passages at regular intervals leading to every part of it and arrangements made for draining off rainwater to any lowlying or cultivated area. The area trenched each month should be marked by a plate fixed to a peg or post with the month and year painted on it, and a plan of the ground should be kept in the office on which all such particulars should be noted for ready reference. It is better to have a few smaller trenching grounds, say one for each ward or a suitable combination of wards, than a big one situated at a considerable distance from the town, as the former plan helps in the early disposal of sewage and does away with the nightsoil carts moving through the streets up to a very late hour in the day.

The sanitary officer should always look personally to everything and keep a very strict eye on the working of the trenching ground coolies who are very difficult to control, and are never without any excuse and apt to set up trouble at the slightest cause. If there be any lack of supervision the methers would almost always make the trenches too deep or fill them with too much of nightsoil with the result that trenching becomes an absolute failure, especially during the rains

“when owing to the high waterlevel in the sub-soil, everything trenched is brought to the surface by the gases of putrefaction, and the entire area trenched becomes a pestilential bog, crawling with maggots, bubbling with the foulest odours and swarming with blue-bottle flies whose chief delight is to frequent the houses in the neighbourhood and infect both food and drink.” In short the nuisances arising in a badly managed trenching ground are the smell and flies. As these coolies or diggers are apt to absent themselves from work without any previous notice or cause it is a sound plan to keep a number of trenches sufficient for at least three or four days’ use always in reserve. Difficulties of such a nature can best be solved by providing the coolies as well as their Jamadar with free quarters at one end of the trenching ground and a good supply of drinking water so that they can be kept more easily under control. It is also a good plan to grant each cooly a few cottahs of land free of rent for cultivation and in this way they can be induced to stick to their appointments permanently. The Jamadar in charge should always remain present at the ground, distribute and supervise the work of the coolies, collect tickets or tallies from the methers and carters to ascertain the number of trips each makes and see that the carts are not unnecessarily detained, and that they are washed properly soon after unloading. If the trenched areas are leased out for cultivation he should see that his men do not use the crops as their own property and should report to the officer-in-charge of any neglect or insubordination on the part of the coolies. He should also see that the lids of all the carts coming to the ground are properly sealed ; if not, he should report the name of the carter to the Sanitary Inspector for necessary action.

It is usually very difficult to get the people of this country to cultivate a trenching ground as they hardly appreciate the value of nightsoil as a fertilizer. Moreover their religious and

social prejudices are exceedingly strong, and it is not uncommon to find people who have anything to do with sewage farms exposed to social and caste pressure or ostracised by their neighbours and castemen. In the Punjab, United Provinces and Madras cultivation of trenching grounds has been more successful than in Bengal.

It has been estimated that one pound of human excreta is equivalent to 15 pounds of horse dung or 6 pounds of cow-dung (Macaire and Marcet). The droppings of a sheep has been considered to be of the same value as human excreta.

The other methods that are in vogue for disposing of nightsoil by burying in certain parts of India, *e.g.* the United Provinces, are :

(1) The Thornhill System and

(2) The Pitting System.

(1) **The Thornhill System.**—So named after Colonel Thornhill who introduced it first at Barielly in the United Provinces. It consists in digging shallow trenches, each one being 16 feet long, 5 feet broad and 1 foot deep, at an interval of 6 inches. The soil removed is thoroughly pulverised—an essential point—and two inches is returned to the trench into which the contents of one or two nightsoil carts are tipped. If the nightsoil is mixed with earth the whole of the remaining earth need not be put back. A depth of one foot is necessary as otherwise flies breed in large numbers. Land so trenched does not ordinarily require manuring again till the fourth year.

(2) **The Pitting System.**—This system is practised at Lucknow and a few other places, and consists in selling the nightsoil direct to cultivators under certain conditions. The procedure adopted at Lucknow is, according to Colonel S. A. Harris I.M.S., as follows :—

“When a cultivator desires to purchase the nightsoil, he

applies to the Municipal authorities. Before his request is granted the locality in which it is proposed to utilize the manure is visited by the Assistant Health Officer or the Conservancy Inspector, who reports whether the situation is suitable. If this be the case the nightsoil is removed by the Municipality to the spot and there deposited in pits, 2 to 3 feet deep and 5 to 12 feet wide. The pits are dug by the cultivators and are inspected by the conservancy jamader when completed. The manure remains pitted about three months and is then spread in the fields and ploughed in."

At Meerut nightsoil is also disposed of by converting it into manure in pits outside the city and sold to cultivators and to the Cantonment grass farm; but during the dry months, viz. November to May of each year, it is sold after collection to brick burners. The Municipality has also started a grass farm of its own chiefly to utilize the unsold manure in growing grass for sale in the city.

The system of trenching nightsoil works successfully only in places where a really good ground and a thorough supervision can be had. This process is not at all economical and is productive of very serious nuisance if there be any laxity of supervision.

The **Nasik System** of pitting nightsoil consists in disposing of human excrement into a regular system of pits with a view to ripen it for sale to cultivators. The pits are covered with a layer of *kachra* or town sweepings which form an efficient air and fly seal. When gases of putrefaction escape the openings are patched up with fresh *kachra*. The drying and ripening of nightsoil takes place slowly. The nightsoil is not mixed with earth which lowers its manurial value by diluting it and giving it a poor reputation with the cultivators. This process can be applied all the year round and heavy rains do not in any way interfere with this system. The pits in a heavy soil should not be more than 2 to 3 feet deep or

nightsoil will not dry. The pits may be made up to 5 feet broad and of any length according to the amount of nightsoil to be deposited on a given day. After a year or so the contents of the pits, dried and ripened, is very like ordinary earth in appearance and is in demand by cultivators.

Incineration of Nightsoil.—To dispose of nightsoil by incineration or burning is a very safe and sound way of getting rid of excreta, as an incinerator is a large disinfectant in itself. This process when properly worked and looked after has the advantage of doing away with all the chances of polluting the air, water and soil.

To dispose of nightsoil inoffensively by burning first of all a properly designed incinerator is necessary. Such an incinerator can be located without any offence near an inhabited quarter, and in case of hospitals within the hospital compound itself for disposing of the infected dejecta of patients. But it is better to construct an incinerator near any agricultural field or low-lying area which can either be manured with, or raised by, the ashes. There should be attached to it a water-tight masonry platform hollowed out in places for mixing the nightsoil with combustible materials, and the whole compound enclosed properly by walls.

Secondly, thorough supervision is necessary. The sweepers and methers as a class cannot be relied upon, and if there is any lack of supervision they will not mix the fuel with nightsoil in proper proportion, or they would introduce too much of the damp mixture into the incinerator while perhaps the fire is simply smouldering. The fire should always be a blazing one before the mixture is put over it.

The fuel should always be dry and in abundance, and stored carefully in an attached godown or shed. Small pieces of wood, wood shavings, sawdust, coaldust, dry leaves, cowdung cakes etc., can be used. Dung, grass and rejected

straw or bedding of animals from the Municipal cattleyards can best be utilised as fuel after drying.

To work an incinerator the portion of the furnace above the grating should firstly be well filled with fuel, then night-soil mixed with the proper proportion of inflammable substances should be gradually introduced in small lumps and spread when the fire burns fiercely. The draught should be sufficient in order to prevent the formation of any offensive smoke.

There are many kinds of incinerators, such as Donaldson's Destructor (for hospitals), Burn's "Silchar" Cinerator etc., serving the purpose for which they have been designed. The 'Silchar' Cinerator, which has been adopted by the Assam Government, can also be made of small portable sizes and used to dispose of filth at fairs or *melas*, camps of exercise or in tea gardens etc. In Bengal there is only one incinerator at Lillooah (near Howrah) in connection with the E. I. R. workshop exclusively for burning nightsoil.

Merits of the Hand Removal System.—Theoretically this system or the dry method of sewage removal is a very sound way of disposing of nightsoil but practically it is fraught with many difficulties. Hardly any advantage can be claimed for this method which might work successfully only in places where a really suitable soil and thorough supervision are available. The drawbacks of this system, however, may be summarised as follows :—

(1) It is a costly system as it entails the employment of a large number of sweepers, vehicular plant and animals. A considerable expense is incurred in repairing the carts, feeding the animals and replacing those that die or become disabled.

(2) It is difficult to manage satisfactorily in towns having a large population—over 15,000 or 20,000, and unless sufficient check can be employed over the methods by maintaining an

enormous inspecting staff, neglect to remove filth is a common occurrence.

(3) The various stages in the transfer of nightsoil are productive of serious nuisance, and if the trenching ground is unsuitable or not properly managed it becomes a source of very great nuisance and a menace to the public health.

Many seaside towns discharge their sewage on the foreshore near low water mark but a great portion of it is returned by the tide causing a serious nuisance. "Sea water is not a satisfactory medium for the purification of crude sewage, partly because it contains a comparatively small number of water bacteria, but mainly because the tidal disturbances prevent the suspended organic matter from undergoing the sedimentation which allows organisms growing in the absence of air and light to do their necessary resolving work."—Rideal.

CHAPTER VII

BIOLOGICAL METHOD OF DISPOSAL OF NIGHTSOIL

Disposal of Nightsoil by Septic Tanks.—A problem which has long been exercising the minds of the sanitarians in India is how the excrement of large bodies of people can be effectively and inoffensively disposed of. The trenching system was generally adopted for want of a better method, but experience has shown that this system is insanitary and prejudicial to health.

The septic tank system has been found to be very satisfactory for dealing with human excrement and does away with all the drawbacks of the trenching system. In this system the nightsoil is subjected to the action of special bacteria in specially constructed chambers which are known as "septic tanks." Colonel W. W. Clemesha, I. M. S., along with Dr. Fowler, was the first to scientifically study the biological process of sewage disposal in the East, and what is called a "Dumping Septic Tank" is undoubtedly a great improvement effected over the trenching process.

A dumping septic tank is simply a modified septic tank latrine. Instead of having a large number of seats on its roof as in the case of a septic tank latrine it is provided with a trapped annular opening and a soil pipe through which nightsoil is introduced into the chamber or tank underneath. Such an installation can best be started in places where suitable land for trenching purposes is very difficult to obtain but where an ample supply of water—as from canals and rivers—can be had, as water is absolutely necessary for diluting the sewage, and also where the effluent can be easily disposed of. The effluent which has high fertilizing power emerges as clear as water and after passing through filter beds escapes

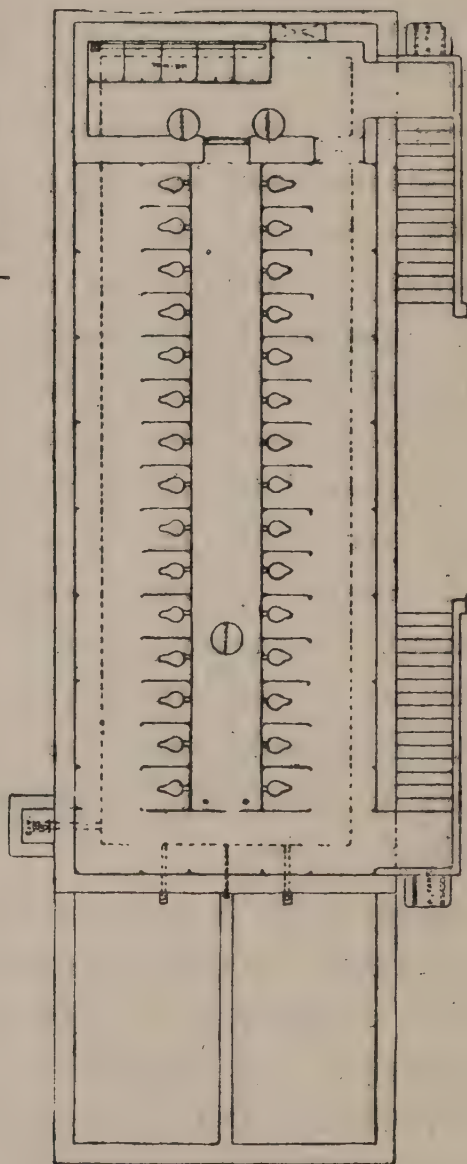
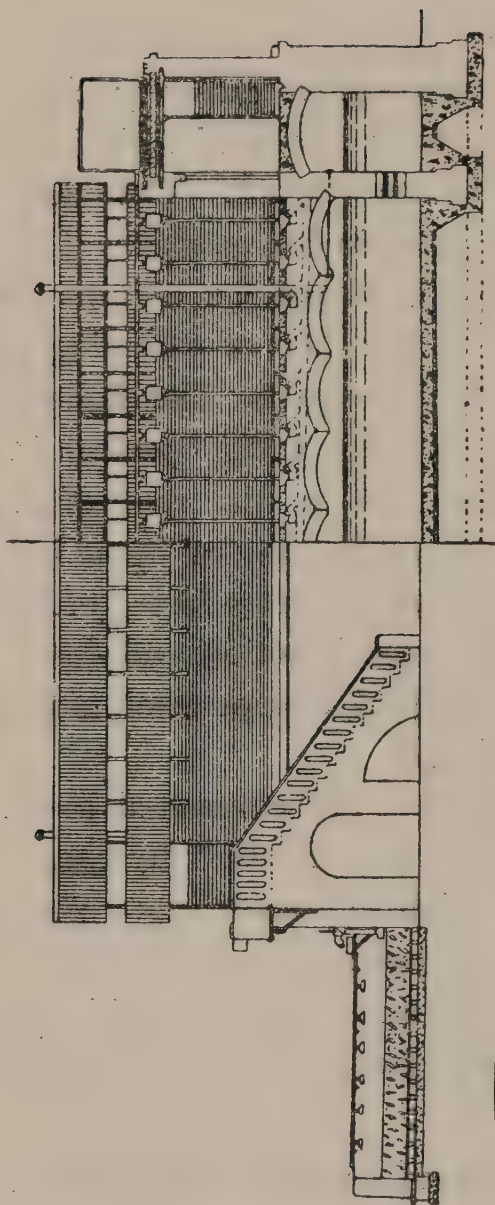
as an odourless and colourless liquid. It should not be allowed to run to waste but utilised for manuring cultivated areas, grass lands etc., and as much as 5,000 gallons can be distributed over an acre of land per diem.

A *septic tank* is nothing but a rectangular masonry chamber from which air and light have been excluded with filters attached to it for the purification of the effluent. The dumping tanks should always be constructed in the outskirts of the town or in isolated places in order to spare the citizens the discomfort that they must feel at the time of dumping or emptying the carts or buckets of their contents. The nightsoil should be introduced into the tank through a big opening fitted with a non-absorbent annular pan on the roof of the chamber at one end; the opening should be guarded by an iron grating to prevent bricks and other large objects from getting into the tank and interfering with its septic action, and should also be kept covered by a tight-fitting lid, except when nightsoil is introduced, to minimise nuisance.

The water supply should be from a tap connected to an elevated reservoir to which water should be raised by means of a pump. For every gallon of nightsoil about 125 gallons of water are required for effecting the necessary dilution of sewage. The washings of the carts and buckets should also be thrown into the tank. The flushing arrangements must be of the simplest kind.

In the septic tank system the complex organic matters of the human excrement are converted into simpler products by the action of bacteria, viz., the anærobic and ærobic, present in the sewage. The former class of organism is chiefly concerned in reducing the organic substances of the sewage into simpler chemical products, chiefly ammonia, by breaking down, digesting and liquefying the fæces, while the latter converts by process of nitrification the ammoniacal substances into

— HALF ELEVATION AND SECTION —



— PLAN —

Figs. 30 and 31. Septic Tank Latrine. (Civil and Sanitary Engineering Co., Bird & Co., Calcutta.)

nitrites and nitrates. The anærobic bacteria flourish in the absence of air and light in the septic tank, while the ærobic ones in the presence of air or oxygen in the filter beds.

Hence the action of the micro-organisms on the sewage after its introduction into the septic tank may be divided into two stages, viz., the first stage or the stage of liquefaction and the second stage or the stage of purification. The tank should always be thin and 5 to 6 times as long as it is broad. The effluent should come out through a discharge pipe at the end opposite to that of the inlet at a point midway between the scum at the top and the sludge at the bottom to prevent the solid particles of fæces from coming out. In order to prevent pieces of stones, bricks or hard lumps of fæces from entering the tank proper and interfering with its action a portion of it, about one-eighth of its length, is usually cut off on the inlet side by means of a wall. This small compartment, called the *grit or detritus chamber*, communicates with the liquefying tank through an opening near the bottom of the partition wall and its floor is slightly dished out for the lodgment of bricks or other heavy particles. This portion should be adequately provided with shafts for the escape of gases, some of which are inflammable.

All foreign and insoluble matters are taken out periodically from the detritus tank. Anærobic action takes place in the liquefying or the septic tank proper. The rate of flow of the sewage through the tank should be such as to allow of proper bacterial action taking place. If the sewage passes through rapidly the bacteria do not get sufficient time to do their work properly and consequently the effluent that comes out falls off in quality and gives off a fæcal smell.

The sludge accumulates very slowly at the bottom of the tank and consists of indigestible material, mineral matters, cellulose, vegetable and elastic fibres etc., while the scum at the top consists principally of bacteria and is not infrequent-

ly a few inches deep in most active septic tanks. The sludge should never be allowed to exceed one foot in depth and it is better to remove it once in three months and dispose of same by trenching.

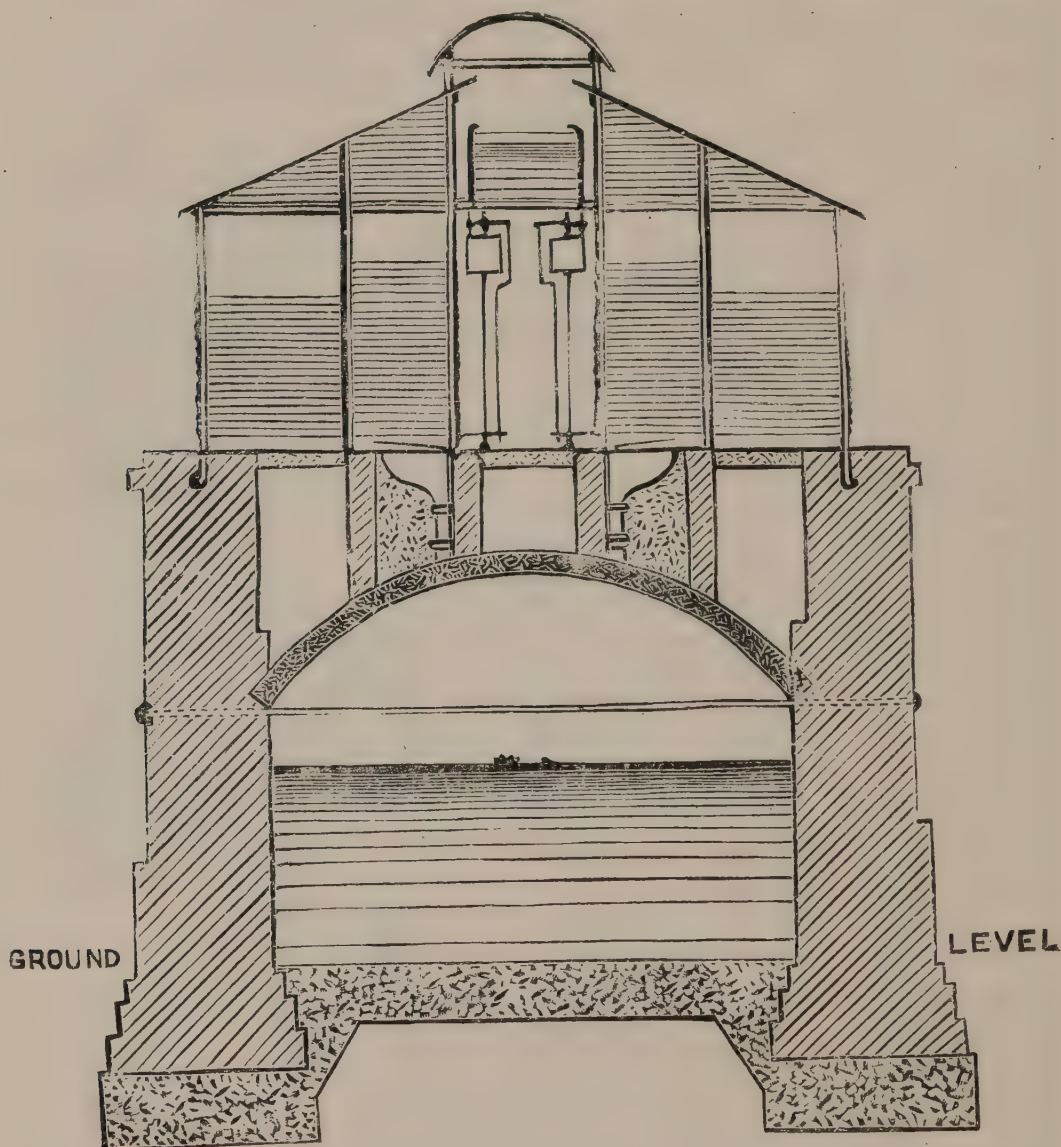


Fig. 32. Cross Section of a Septic Tank. (Civil and Sanitary Engineering Co., Calcutta.)

The effluent coming out from the liquefying tank may, if necessary, be further purified by means of ærobic filters, or allowed to run over some cultivated plot. The best way of getting the effluent purified is by distributing it by means of spreaders, either of the fixed or moving type, on to the bacte-

ria (filter) bed, which consists ordinarily of a mass of substances like *jhamā*, cinders, etc., having a large amount of air spaces inside for the proper growth and development of the aerobic organisms. These materials should always be scientifically graded from above downwards. The filters should be close alongside the septic tanks.

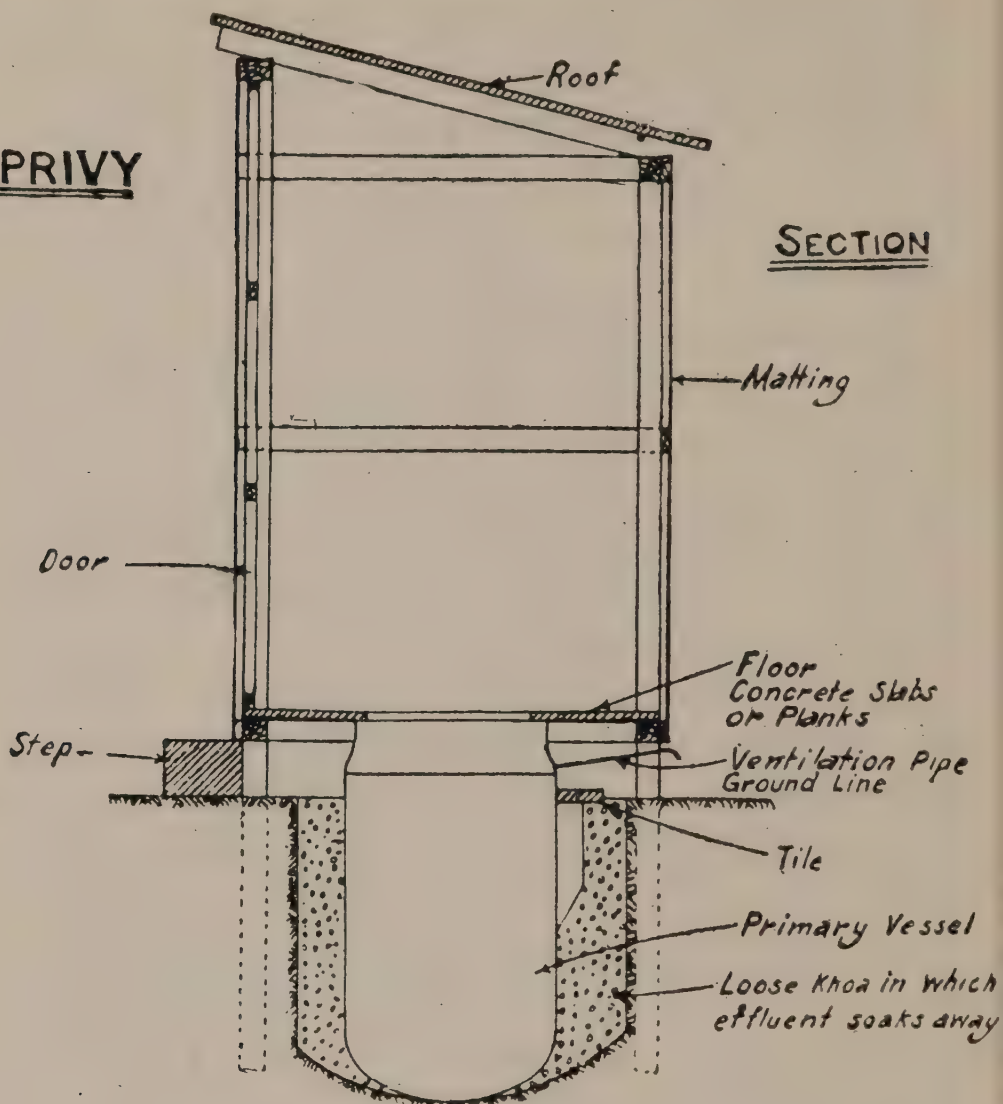
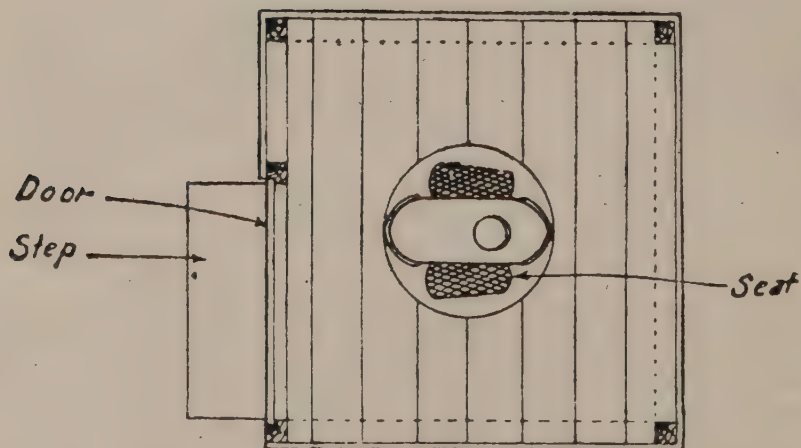
The last stage is the further purification and sterilization of the effluent by the use of chlorine, if it is intended to allow the liquid to pass into rivers or water courses from which the drinking water supply is obtained. Five grains of good chloride of lime is sufficient to sterilize a gallon of bad effluent. A sample of good chloride of lime should yield about 33 p. c. of available chlorine.

When newly started the work of the tank should be gradually pushed on and it takes about six months to give a satisfactory effluent. In all tanks the quantity of sewage must be in proportion to the number of bacteria, and if more work is thrown on the organisms, they cannot do their work properly with the result that the effluent falls off in quality and gives off faecal smell. It is believed that the presence of urine hastens the septic action. Two points are to be considered before starting a septic tank—firstly the question of water-supply and secondly what is the best way for getting rid of the effluent.

The advantages of this method of disposal of nightsoil over the trenching system have been claimed to be as follows :—

- (1) It is sanitary.
- (2) The installation can be worked equally well in dry as well as in wet weather and is not upset by floods.
- (3) The whole of the sanitary imperfections of trenching grounds, such as filling the trenches too full of nightsoil, breeding of flies and many others, disappear.
- (4) On the whole it is cheaper in the long run.

Aqua Privy.—The “Aqua” privy which is the invention

AQUA PRIVYSECTIONPLAN

Figs. 33 and 34. Section and Plan of Aqua Privy. (Jas. Lumsden & Co., Sanitary and Septic Ltd., Calcutta.)

of Mr. Griffin, Assistant Sanitary Engineer, Bengal, is designed to conform with the customs and prejudices of Eastern peoples. The offensiveness and danger of the hand-removal system is well known, and its cost is considerable, amounting in a municipality of, say, 11,000 inhabitants to some Rs. 10,000 a year. In the "Aqua" privy system the nightsoil goes straight into a small septic tank under the privy seat. Therein, by septic action, some 90 per cent. of it is liquified, so that the tank only requires emptying at such long intervals as a year or so. Thus the cost of clearing is reduced from Rs. 10,000 a year to, perhaps, Rs. 1,500. The privy consists of a cylindrical tank having a drowned outlet, and a separate upper piece with which is embodied the "seat" or foot-rest. The floor is fitted to a groove in this upper piece, and any sort of superstructure may be erected over it, consistent with decency and convenience. Fig. 33 shows a complete privy. An essential feature is that the tank must be watertight, and this is successfully and economically achieved by the use of reinforced concrete. The capacity of the present design is arranged for the use of from four to six people, but larger capacities can be designed as required. The tank is filled with water before use commences, and in addition to the nightsoil and urine going into it, a certain amount of water has to be added, as described later. There is a small amount of effluent fluid from the overflow to be dealt with, but this is so small that it can be allowed to soak away into the ground round about, or, in the case of congested areas or privies near wells, it may be collected in a vessel and disposed of near at hand, or may be passed into a pucca drain, provided the same is properly flushed. It also has good manurial value when used for watering gardens, etc. A small ventilation pipe is fixed from a hole in the upper piece to the outside of the privy.

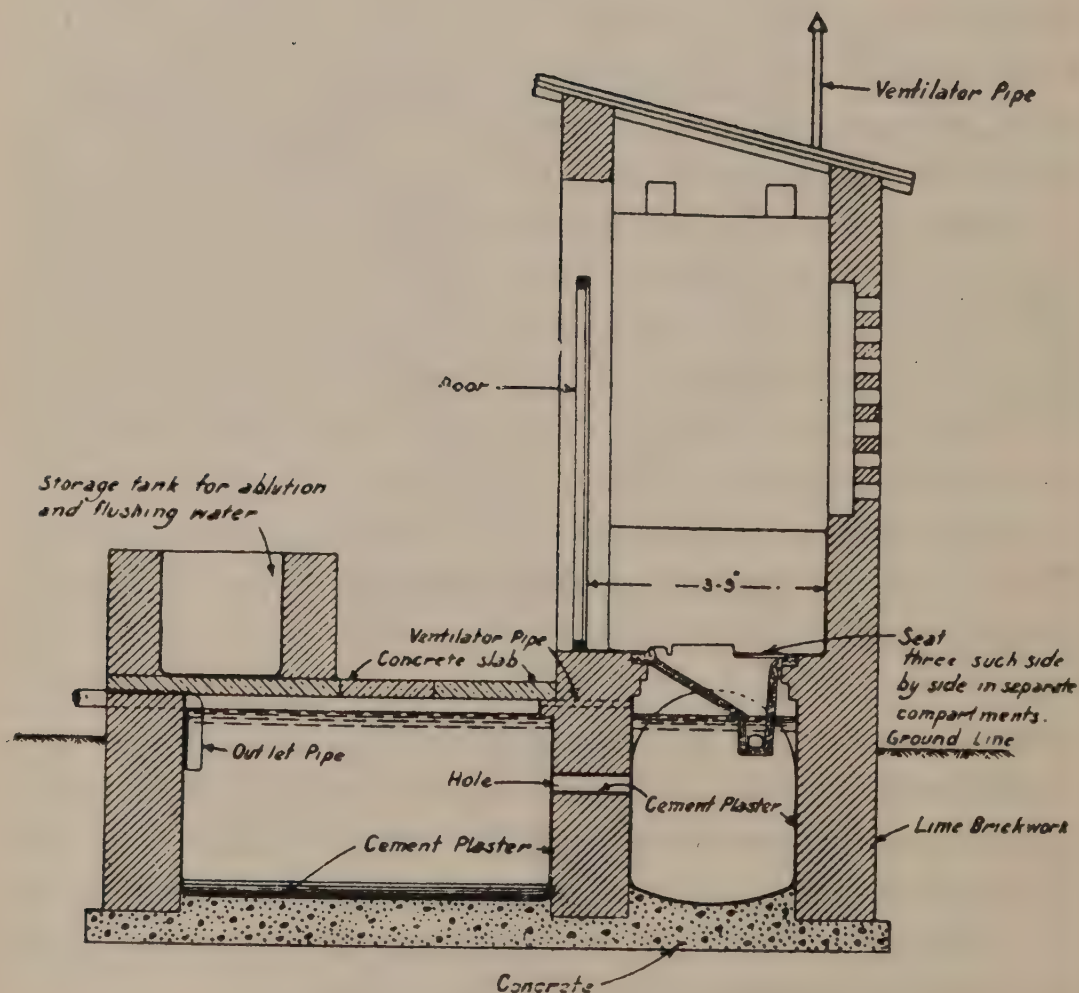
The invention is put forward in two forms—

- (1) The open top.

(2) The funnel top.

The first has the advantage that it is extremely simple and there is nothing to get fouled, so that it will work for a year or more with practically no maintenance cost. Splashing is prevented by means of a netting supported just below the surface of the water. If used in the plains, however, it has the disadvantage that kerosene must be used to kill

SECTION OF MULTIPLE AQUA PRIVY



Figs. 35. Section of Multiple Aqua Privy. (Jas. Lumsden and Co., Sanitary and Septic Ltd., 15 Clive Row, Calcutta).

maggots. It is therefore recommended for use in the hills, where maggots do not give trouble. Ablution water is allowed to fall into the privy, and in addition a bucket or two of water a week must be added. In cases where ablution water is not used, a corresponding amount of additional water must be added.

The second type may be used anywhere. In this a funnel dips down into the water. It is closed at the bottom, but has two openings at the sides $2\frac{1}{2}$ " below the water-level. The excrement drops into the water in the funnel, and is then flushed into the interior of the tank by dashing a small bucket of water into the funnel. There is then no exposed surface of nightsoil, no smell, and no danger of breeding maggots. The best way is for the user to bring sufficient water with him to do this flushing in addition to his ablution, otherwise the sweeper may be called to flush. To this, however, there are two main alternatives which must be considered, and it will be seen that even when the privy is neglected, no harm results. First, the users bring only their small quantity of water sufficient for ablution, and the services of the sweeper are called in once or twice a day to clean the funnel and flush it with a bucket of water. This is a fairly satisfactory arrangement in that the nightsoil is not exposed for long and the breeding of maggots is prevented. The second alternative is that the sweeper is not called in regularly, and the funnel is left unflushed for more or less long periods. No very serious disadvantages, however, follow from this, provided ablution water falls in to keep up the septic action. For fresh nightsoil is continually pushing the old nightsoil (in which flies' eggs may have been laid) through the trap into the tank, and although maggots may be living there, they are imprisoned within the airtight space under the seat, and flies which hatch out are soon asphyxiated. It may be argued that flies are liable to pitch on the exposed nightsoil and then

fly away and contaminate food. This is possible, but the amount of exposed surface of nightsoil is much less than with the existing conservancy systems, and therefore the danger of this contamination is greatly reduced.

A modified design is especially for use in places where neglect of flushing is likely to occur. It is so arranged that the nightsoil falls direct on to the water, and therefore very little fouling of the sides of the funnel need occur.

The inventor has also prepared a type of upper piece, of European pattern. The usual form of pan is provided, which terminates in a similar funnel arrangement to that previously described. This form of privy however, is, recommended only under certain conditions with regard to use. The chief of these are; first, that water ablution should be adopted if possible; otherwise only the thinnest toilet paper should be used in the smallest possible quantities; and, second, that flushing (which is to be done by hand) must be moderate.

If a privy goes out of use, it must, of course, be thoroughly flushed or emptied. Emptying is done by lifting off the floor and upper piece, and removing the contents of the tank with scoops and buckets. The whole of the contents should not be removed, since the tank is immediately re-filled with water, and a small amount of sludge remaining helps the restoration of septic action. When a privy is first started, the septic action or "digestion" which is set up by bacteria carried in with the nightsoil, comes into full operation two or three months after use commences.

For the prevention of hookworm infection, when it is desired to use a funnel top with flushing, a secondary vessel becomes necessary in order to increase the septic action.

For households of more than five persons (in the case of the "Aqua" privy without secondary vessel) or more than eight people (in the case of the "Aqua" privy with secondary vessel) two or more privies must be installed as required.

When, however, the number of privies for the household or community to be served rises to seven or eight, it may be more economical to build a tank *in situ* of the required capacity, provided materials and skilled labour can be locally obtained.

A section of a design prepared by the inventor on these lines is shown in Fig. 35. Its capacity is about 760 gallons with three seats, sufficient for the daily use of 50 persons. In such a latrine, more careful arrangements must be made for the disposal of the effluent. To use it for irrigating a garden is a very good system. The working cost consists of the wages of one *bhisti* and one sweeper. The *bhisti* carries water from the nearest tank or other source of supply and fills the storage tank. From thence users take their ablution water, and the sweeper takes the water required for cleaning and flushing the seats by hand.

It will be at once obvious that the "Aqua" system meets the needs of an enormous class in India, and the fact that it has been already tried and proved by some of the most experienced sanitarians in India is evidence of the merit of its claims. Dr. Bentley is of opinion that it is superior to the ordinary service privy and thinks that the use of the "Aqua" privies will greatly minimise the chances of infection from cholera and typhoid fever, and that they will prove an almost certain preventive of hookworm infection.

CHAPTER VIII

DISPOSAL OF SULLAGE

For the satisfactory removal and disposal of sullage or the waste liquid of a town unmixed with faeces a system of drains is necessary. In the mofussil towns this waste liquid is almost as impure as the sewage of water-closetted towns, as it consists usually of (1) waste water from kitchens ; (2) house slops containing urine and dirt from the surface of the body and from clothes ; (3) liquid refuse and drainage from cattle-sheds, stables etc., (the drainage from stables is very rich in urine as a healthy horse excretes about 15 times more urine than an adult man) ; (4) urine and water from public urinals etc. ; (5) street washings and drainage of land, rain and storm water, and (6) waste liquors from factories.

This foul liquid in wealthy municipal towns—is ordinarily removed by masonry drains, but for its removal the revolving body nightsoil carts are also quite as good. Other strong carts fitted with screw down outlet valve with airtight manhole lids will do as well, but carts provided with valves are, however, likely to leak. In towns where such a system cannot be installed,—and the number of such towns being by far the largest,—all sullage is usually conveyed by *kutchas* or non-masonry drains. These *kutchas* drains, which were primarily devised for carrying away washings from the house and kitchen together with rain and storm water are nothing but shallow channels scraped in earth alongside the dwellings and roads. They are very inefficient and difficult to keep clean and their general plan and construction are faulty in the extreme. It is generally to be found that their sides have not the proper slope to prevent the falling in of loose earth, their bottom not sufficient inclination to allow the water to pass with sufficient velocity so

as to carry off solid filth and prevent deposit and soakage of fluid; weeds and grasses grow on the sides and in the bed of the drain, rats throw out heaps of earth by burrowing and during the rains the villagers frequently obstruct the flow of water by dams or traps to intercept fish. These roadside surface drains are also obstructed by erecting projections (culverts and bridges) which are often of too great a length to permit of proper cleansing and used for latrine as well. The consequences of such a practice are obvious; they form suitable breeding grounds for mosquitoes, and pollute both the soil and atmosphere and any neighbouring water supply by percolation. Such obstructions should be removed or reduced to a minimum by making the culverts as narrow and as far apart as possible.

If any existing projection interferes with the proper cleansing of the drains the owner should be served with a notice to remove the obstruction, and when a drain passes underneath the road, arrangement must always be made for readily exposing portions of it, as by leaving apertures guarded by lids or doors, for cleansing. A record of all such structures should be kept in the office showing how long they have been in existence, whether or not any proper arrangement for cleaning the drain can be made without removing the culverts or bridges, whether the culverts can be allowed to stand on certain conditions to be imposed on the owners, and whether or not any compensation should be awarded in case the removal of the projections be found necessary as demolition of them would give rise to very great opposition. Very often a strong iron plate will be found to be a good substitute for a masonry culvert for covering up such drains as it can be easily removed.

As weeds and other small plants growing on the bottom and sides of a *kutchā* drain materially impede the free flow of its contents coolies should be engaged to remove them as

often as they grow and also to maintain the level of the drain. Deep drains should be avoided as they are difficult to keep clean and consequently become foul. *Kutchas* drains, if not properly looked after, become no better than elongated cesspools and consequently act as a menace to the public health. Therefore care should always be taken to maintain a suitable fall during their cleansing which usually consists in scraping the bed and removing all jungly growths. A drainage cooly can ordinarily scrape with the kodali about three hundred running feet of an average sized *kutchas* drain every morning, but the progress of his work depends on the width of the drain and amount of silt and vegetations to be removed. In raising the bed level of the drains the work should always be commenced at the highest point of the drain, whereas in excavating silt from the point nearest the outfall, by adopting as high a level as possible at the head or commencement of the drain, better falls or gradients, which help very greatly in self cleansing, are obtained.

During the cleansing or scraping of the *kutchas* drains care should always be taken not to convert them into mere trenches with no fall. Their bed level should be permanently marked by what are called 'bed bars' at a distance of about a hundred feet from each other. These bed bars which are nothing but concrete blocks shaped to the proper profile of the drains serve as checks and prevent the bed of the drain from being unduly lowered during scraping. The silt that is dug out and placed on the roadside should be promptly carted away or it may be dried in the sun and used for dressing the road flanks. The *kutchas* drains generally require regrading once a year just before the rains.

Another common fault of the drains in the Indian towns is the want of any suitable outfall. In most cases they empty their contents into tanks or *dobas* by the side of the road, while in other cases they simply lead out in the open

country and terminate in the paddy fields or marshy lands, which ordinarily remain full of water during the rainy season and sometime after. During all this time the village drains remain more or less full of water and thus keep up that saturation and humidity of the subsoil and foundations so detrimental to the health of the people.

Besides the *kutchra* drains there is another variety of drain known as *kutchra-pucca* drain which is generally used in Bengal. This type of drain, though inferior to the *pucca* or masonry drains, is satisfactory, and with proper attention lasts for a long time.

All such drains should, whenever possible, be replaced by *pucca* or masonry surface drains. These should be rendered absolutely watertight by cementing, or be constructed of non-absorbent materials, *i.e.* channelled stoneware or Indian

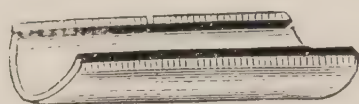


Fig. 36 Glazed stoneware V-shaped Surface Drain Pipe. (Civil and Sanitary Engineering Co., Calcutta.)

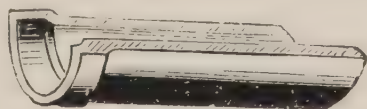


Fig. 37 Glazed stoneware Half-round or Surface Drain Pipe. (Civil and Sanitary Engineering Co., Calcutta.)

patent stone pipes etc. They should always be properly devised and graded, and flushed and cleaned daily by employing an adequate staff of sweepers. The most suitable form for *pucca* surface drain is the egg-shaped one with the small end of the egg downwards. Such a drain can be completely flushed and cleaned with a brush and a small quantity of water supplied by a *bhisti* or waterman from his bag, but

the best arrangement for flushing drains will be to let the water run from an elevated reservoir at the head or highest point of the drain. If *pucca* drains are properly laid the current is usually strong enough to prevent the deposit of solids and mosquitoes from breeding. The self cleansing velocity of a drain should be about three feet per second. Besides, the efficiency of a town drainage also depends on a great degree upon its outfall, which may be a river, a canal or a marshy tract. Unless the *pucca* drainage system is kept thoroughly clean it will be found to be a source of serious nuisance especially during the dry season.

Owing to the cost poorer municipalities which cannot take up a wholesale scheme would do well to introduce *pucca* drains gradually. The more important or the congested parts of the town should first of all be taken up, and when the residents once appreciate the advantages of a proper drainage system they often come forward to support such a work with contributions when once a start has been made. Moreover, the Government is always prepared to grant an aid whenever any such work is taken up. But so long as this is not done the municipality must provide a regular sullage service for the town, or at any rate for the more crowded areas by employing a set of carts and a special staff.

Disposal of Sullage.—As mentioned before no difficulty is experienced in getting rid of sullage in a town provided with a complete system of *pucca* drains which usually discharge their contents in rivers, marshes etc. But in their absence it can be disposed of by trenching or by applying on some agricultural or waste plot of land. If trenched the earth at the bottom of the trenches should be always loosened so that the foul liquid can be readily absorbed.

But by far the best and most efficient way of dealing with this foul liquid is to pass it through what is generally called a „Bacteriological or Sullage filter” which consists of a series of

watertight masonry tanks containing materials like broken *jhama* (vitrified brick) having a large number of pores or air-spaces in it. Certain micro-organisms known as the ærobic organisms grow and develop in these pores in the presence of oxygen (air) and help in the purification of the sullage during its passage through these filtering materials. The final effluent that comes out looks somewhat dirty but inoffensive, and as it has a high manurial value it can be utilised for rejuvenating cultivated lands, grass-fields etc.

Such filters have been used with satisfactory results at Howrah and Ranchi. In both these places the sullage from the carts is first discharged into a sump from which it is conducted through an opening at the bottom to masonry settling tanks attached to it. There the liquid is allowed to remain for an hour or more, so that all the grosser suspended particles fall to the bottom while any floating substances are removed. The precipitate is later on collected and trenched. The partially clarified sullage is then allowed to pass into an empty space underneath the false bottom of the main filter, composed of broken *jhama* about 18 inches in depth and becomes purified during its passage upwards through these filtering materials by the activity of the ærobic bacteria. The effluent, which is still foul and offensive, is further purified by passing it over an ærating trough and then again through a series of subsidiary filters. The upward system of filtration is always adopted, and the filter works automatically under the force of gravity. The final effluent is turned on to land where grass or vegetables are grown. The Howrah filter deals with about 20,000 gals. of sewage daily and requires a grass bed of about 5 bighas, and the yield is about 6 maunds of dhoob grass per 100 sq. ft. annually. The work of such filters should always be gradually pushed after first starting them in order to allow the organisms in the pores of *jhama* time to grow and develop. If a large quantity of sullage

is introduced at the very start then the number of organisms being too small in proportion to the amount of work thrown on them they will not be able to purify the liquid properly and the effluent will fall off in quality. The filtering medium requires to be changed when a foul effluent begins to come out, and after each new charge the work should be gradually increased. The filtering media are generally changed once or twice in a year. It is better to have a double set of filters, so that when one is thrown out of action the other is put to work. The washings of the carts etc., should also be treated by these filters.

In the country districts where no system of drains ordinarily exists all slops are thrown out of the door and allowed to soak in the ground or form offensive puddles. All such water should be received in water-tight pits or receptacles which should be emptied daily and their contents applied on to some agricultural field.

CHAPTER IX

CONSERVANCY ARRANGEMENTS IN FAIRS AND MELAS.

Before any fair or *mela* is held the probable number of pilgrims should always be carefully estimated and the conservancy arrangements made accordingly. The number required for the conservancy establishment, i.e., sweepers, methers and carters, latrines, vehicular plant and other appliances, should not only be in proportion but the authorities must also keep themselves ready to meet the requirements of any probable increase in the number of pilgrims. The latrines should be of the trench variety, separate for men and women and properly screened. Such latrines should be dug in selected sites, suitably distributed and each user instructed to completely cover up the excreta after each visit with some loose earth which should be stored within the latrine enclosure. Sweepers should be in attendance there with shovels and spades for covering up or digging trenches and also for sweeping the *mela* ground.

It is better to dig trenches about 25 feet long, 8" to 10" wide and $1\frac{1}{2}$ '-2' deep and to enclose them properly by bamboo mats. Such a trench should be divided into eight cubicles—each measuring about $3' \times 4'$ —by partitions made of mats. In each cubicle, if the sides of the trenches are loose, wooden planks should be placed across the trench for the users to sit. The entrance should be away from the *mela* side. If necessary small separate trenches for rich and respectable pilgrims might be made and the cost for their upkeep realised from the users. Pits for dumping all sorts of rubbish may be made near the latrines. The body of any animal dying at the fair should be carted away from the *mela* ground and buried with its skin intact in a bed of lime or burnt.

Slaughtering of animals should only be permitted at fixed places.

There should be an adequate staff to look after the sanitary condition of all the lodging or pilgrims' rest-houses, which are to be kept reasonably clean and provided with proper privy accommodation and a pure water supply. The conservancy staff should also guard against the commission of nuisance anywhere except in the places specially set apart for the purpose. Attached to each latrine and in other suitable sections there should be urinals separate for each sex. Pits might be made and used as urinals with bricks for footrests and earth thrown into them whenever they become offensive. A good plan would be to fill up the pits with cinders so that all urine might at once be absorbed. The urinals should be in accessible positions, enclosed by screens and partitioned off. But a better arrangement will be to use tin canisters which are cheap, non-absorbent, easily cleaned and disinfected, and a few ounces of a disinfectant solution like phenyle or cyllin should be put into them before use. There should be a sufficient stock of chloride of lime or other disinfectants at the mela camp.

When a mela of any importance is held the sanitary officer with an adequate staff of subordinates and sweepers should proceed to the place sometime before its commencement for making all necessary sanitary arrangements and stay there all through the mela period in temporary quarters to be built for them. After the mela is over, and before he returns to his headquarters, he should see that all the trenches etc., are filled up, all rubbish removed and all sanitary appliances collected and stored carefully.

PART III
CATTLE MANAGEMENT

CHAPTER I.

PRELIMINARY REMARKS.

Every municipality is required to maintain a sufficient number of animals for properly carrying on the work of the conservancy department. Cattle (bullocks and buffaloes) are universally used, but big municipalities employ ponies or horses in addition. In certain parts of India, e.g., the United Provinces and the Punjab, donkeys and mules are also employed for removing refuse especially from the narrow streets and bye-lanes. Horses or ponies are to be preferred to horned cattle, as they make more trips, work quicker and draw better, last longer with ordinary care and much less subject to diseases; but their upkeep is rather costly. Mules, though strong and quick workers, are troublesome and vicious. They are apt to fight with each other and also to bolt with the carts. They are not well-fitted constitutionally for work in a damp and hot climate like that of Bengal.

Buffaloes, though strong and hardy, are slow, lazy and troublesome, but they can pull heavy loads. They are usually employed in the municipalities for drawing heavy nightsoil carts having a capacity to hold about 100 gallons each, and in Calcutta for the big refuse carts. A buffalo, if unruly, is dangerous and should be got rid of. The cost of their feed is about 50 per cent. higher than that of bullocks and the amount of work they do is generally twice as much. The annual loss of animals from death and disablement may be estimated at one-fifth of the total stock, but this percentage may be appreciably reduced if the animals are well fed and

housed, properly cared for, protected from being poisoned by the hide-dealers or *chamars*, and from the onslaught of infective diseases by prompt repressive measures.

Conservancy officers must always keep a strict eye on the carters and should see that the animals are properly looked after and harnessed when taken out for work. The common habit of riding on the carts, usually on one shaft, should be checked by admonition and fine, as this drags the weight unequally one side and so is sure to gall the animal. After emptying the contents of a refuse cart the men usually let the body of the cart fall back to its place on the shafting instead of replacing it gently by hand. This not only brings on a rapid tearing of carts but is apt to injure the animal's spine and may eventually paralyse and ruin it for good. Again, when bullocks are restive and troublesome in the carts, the drivers sometime blind them by applying the milky juice of *lalchitra* (one of the *Euphorbias*) in the eye. This causes a dull white opacity of the eyeball and destroys the eyesight completely. Merciless flogging or torturing of the animals by twisting their tails etc., should also be checked by prompt and suitable measures.

A good cattle-yard, popularly known as a *Gowkhana*, is necessary for the comforts of the conservancy animals. In big towns it is usual to place it in charge of a special officer (commonly called the Superintendent), possessing some veterinary qualification, while it is desirable that in smaller towns the sanitary inspector who is ordinarily entrusted with the care of the animals should also possess a general knowledge of animal diseases, particularly of the infective ones, as by the timely recognition of a case of a communicable disease among the animals in his charge, he can render an immense service to the municipality by enabling it to take prompt measures to prevent the spread of the disease. The Sanitary Inspector must not pretend to know everything

about veterinary science and should call in a qualified man when any difficulty or doubt arises.

Duties of the Gowkhana Superintendent.—The Superintendent or the officer in charge of the Gowkhana or cattle-yard should always work in co-operation with the conservancy staff. He is personally responsible for the proper management and cleanliness of the cattle-yard (including the carters' quarters), the proper feeding of the animals, the maintenance of discipline and efficiency among the staff, the distribution of work and the arrangements for fodder. He should look to the cleanliness of all the carts and examine them on a fixed day in each week. He should also see that all harness, whether in use or in store, are kept carefully greased and in good order. All trifling or minor ailments of the animals may be treated by him, but he must at once report any outbreak of infective diseases to the authorities and segregate immediately all the affected ones. He may also at times be required to purchase animals, so it is necessary that he should be able to select healthy and young animals. He should maintain, among others, the following registers :—

- (1) Register of animals (live stock).
- (2) „ „ sick animals.
- (3) „ „ carters.
- (4) „ „ carts.
- (5) „ „ accounts.
- (6) A list of saddlery, baskets etc.

Gowkhana or Cattle-yard.—This should be centrally located and properly constructed. A *gowkhana* should consist of :

- (1) Stalls both for horses and cattle (*i.e.*, stables and cattlesheds).
- (2) A harness godown.
- (3) Fodder and store godowns.

- (4) Bathing tanks for the animals.
- (5) Drinking troughs.
- (6) A workshop.
- (7) Latrines and urinals.
- (8) Quarters for the Superintendent.
- (9) Office accommodation.
- (10) Quarters for the attendants.

Cattleshed.—This should always be a detached structure having an open space of 15 or 20 feet or more all round and at a reasonable distance from any source of water supply. Each shed should be about 32 feet wide with 2 rows of masonry feeding troughs in the middle separated by a passage for feeding about three or four feet wide.

The *floor* should always be made a bit rough and thoroughly watertight, and raised 6 to 12 inches above the surrounding ground level. It should have a slope (about 1 in 40) leading to an open but water-tight drain, which should end in a watertight vat or receptacle a few feet outside the shed. The floor is best made of Indian patent stone, but there should be such markings on it as would afford a firm footing to the animals. Brick-on-edge floors are not quite satisfactory, as they are not impervious to moisture and the joints become leaky very soon. Iron rings for tethering the animals should be fixed in the floor at regular intervals (5 or 6 feet apart). The floor should be always in a reasonably clean condition and washed every morning after the animals have been taken out for work.

The *walls* should be high enough to prevent the damp and the cold winds of night from blowing on the cattle, and their inner surface, up to a height of 5 or 6 feet, should be thoroughly rendered in cement. All the angles and corners should be rounded off for easy cleansing.

The *roof* may be made of any material so long as it protects the animals from sun and rain. An over-hanging

tilled or corrugated iron roof with a straw ceiling is to be preferred, as it is cheap, strong and lasting. The height of it from the tie rod to the floor should be at least 8 feet.

The *door* should permit of easy ingress and egress, and the ventilation arrangements should be such as to allow the admission of good air below and the escape of foul air above. All windows should be placed above the head of the animals and opposite to each other.

The *drain* or *manure channel* should be at the back of the animals, and run through the entire length of the shed. It should be about a foot wide and 6 inches deep and made either of masonry thoroughly plastered with cement or of glazed stoneware channelled pipes with a decent fall. The *vat* should be at a distance of 5 or 6 feet outside the stable wall and constructed of masonry—its inside being thoroughly coated with a thick layer of good cement so as to render it absolutely moisture-proof. It should be of sufficient size to hold all urine and washing for about 24 hours ; usually $1\frac{1}{2}$ cubic feet of liquid filth is estimated per head of cattle. It should be protected from rain water by a lid or roof and all surface washings should be prevented from entering it by raising its sides a few inches above the surrounding ground level. All dung should be removed to a manure pit, also made of non-absorbent materials, at a few feet away from the shed, and deposited there until taken away for final disposal. Both the vat and manure pit should be cleaned daily.

The *feeding troughs* are best made of masonry without any angles or corners. They should be of convenient size, circular or oval and are very economical, as they are not readily broken and also easily cleaned. Any cracks in them should be immediately repaired. Wooden troughs absorb moisture and rot very soon, and on account of the joints and crevices they cannot be satisfactorily cleaned and so become productive of nuisance ; moreover, the animals (bullocks espec-

ially) are apt to stand with their fore legs in them with the result that the bottoms usually come off.

The points to be noted in the construction of a cattle-shed are that each animal should have a floor space of at least 50 square feet and a minimum air space of 600 c. feet. In short a cattleshed should have an impervious floor with good drainage arrangements, a roof good enough to keep away sun and rain, and should always be kept in a clean and sweet condition. A cheap form of cattleshed may be constructed by making the floor of a mixture of clay, sand or cinders. Firstly, the area to a depth of about a foot is to be concreted. Then *kankur*, sand or tenacious clay (in the proportion of 1 to 10) or gravel and clay (1 to 2) mixed with some cinders should be rammed hard after wetting and then it should be allowed to dry for 2 to 3 weeks. The floor should have a slope of 1 in 40 or 60.

Such a cheap floor requires annual renewing. The best way to keep mud floors dry is by the dry earth system in which powdered dry earth is sprinkled over the urine as soon as it falls and then scrapped off and removed, a little more of the earth is then sprinkled to dry the part thoroughly.

The above principles should also be observed in the construction of stables.

Removal of Excreta.—The amount of urine and dung which an adult or fullgrown bullock passes daily has been variously estimated at 10 to 40 pints and 60 to 70 pounds respectively, whereas a horse voids about 8 to 10 pints of liquid and 20 pounds of solid excreta. All dung and refuse food should be removed from the cattle-shed twice a day and all urine and washings from the vat at least once in 24 hours.

Healthy Animals.—Healthy animals should always be selected and bought. A healthy bull or bullock (cattle) will have a soft glossy coat, moist cold muffle (the terminal portion of face), eyes without tears but looking intelligent with

no dribbling of saliva from the mouth or escape of mucus or pus from the nose. He must be playful and will resent any sort of rough or unkind handling. He must switch his tail and remove flies and other insects from the body by shaking his skin, but there should be no trembling of muscles as the trembling of some of the muscles is an early sign of rinderpest or cattle plague. He should eat and drink readily, ruminate his food well, mix freely with his companions breathe easily (15-18 per minute) and have a pulse beat of 40-50 or even 60 per minute and temperature of 100° - 101° F. He should not be lame and indifferent to surroundings. The lining membrane of the mouth, nostrils and eyes will be light red, the urine pale yellow and the dung soft and greenish-yellow in colour.

The respiration of an animal is counted by standing on its side and placing the palm of the hand on the flank. The temperature is ascertained by means of a clinical thermometer, the bulb of which is introduced into the rectum after drawing the tail on one side. Half a minute or a minute thermometer should be used. The pulse is usually felt on the inner side of the lower jaw bone. In a healthy horse the pulse beat is about 40 per minute.

Points in a Good Bull.—A good bull should have a deep and round chest, strong shoulders, thick and long legs, large and strong joints, prominent and intelligent eyes, large face, broad forehead, short and stout neck, long and fleshy dewlap (loose portion of hanging skin below the neck), large hump and broad back. The quarter should be drooping and feet quite hard or flinty. He should not be very mild, as mildness is characteristic of laziness. A bullock is a castrated bull.

Aging an Animal.—The age is judged by the teeth. It is customary to judge it by the incisors or the cutting teeth in front of the mouth as they are more easily examined. The completion of dentition marks the age of maturity when the

animal gives full work. This in the case of horses is usually 4 years and in cattle about three years and a half when they become adult and quite fit for work.

When dentition is completed a bullock has 8 incisors in the lower jaw and none in the upper, while a horse has 12, *viz.*, 6 in the upper and 6 in the lower jaw. The number of molars or grinding teeth is the same—i.e. 24, six on each side of the jaw—in both cattle and horses. There are no tusches or tusks in the cattle, whereas the horses (males only) have four on each side of the upper and lower jaw, the mares having none. Thus it would be seen that (i) a bullock has altogether 32 teeth (8 incisors and 24 molars); (ii) a horse has 40 teeth (12 incisors and 24 molars and 4 tusks); (iii) a mare has 36 teeth (12 incisors and 24 molars and no tusks or canines). Dentition commences immediately after birth if it has not already commenced in the mother's womb.

The following tables show the period when the changes take place in the teeth from birth to adult age:—

Dentition Table of Ox:—

Teeth.	Temporary teeth.	Permanent teeth.
Incisors :—		
(a) central pair ...	<div> <div>At</div> <div>or</div> <div>soon</div> <div>after</div> <div>birth</div> </div>	(a) at $1\frac{1}{2}$ years.
(b) middle or internal lateral pair ...		(b) „ $2\frac{1}{2}$ „
(c) lateral or external lateral pair ...		(c) „ $3\frac{1}{2}$ „
(d) corners ...		(d) „ $4\frac{1}{2}$ „
Molars :—		
1st.....	at birth.....	$2\frac{1}{4}$ years
2nd	„do „	Between $2\frac{1}{4}$ and $2\frac{1}{2}$ years.
3rd	„do „	
4th... }	upper	4th...at 6 months.
5th... }	and	5th...at about 1 year.
6th... }	lower	6th...at $1\frac{3}{4}$ year.

The teeth in cattle are all shaky. Bullocks and buffaloes when domesticated live up to about 15 years and in wild state to about 20.

In Calcutta when new animals are bought for conservancy work the following particulars are attended to :—

(a) Ponies.—The age should be from 3-8 years. They must be big-boned, straight-limbed and sound ; the cost is Rs. 130/- and the height from 12-2 to 13-3 hands.

(b) Bulls must not exceed 6 years and must stand at least 42 inches at the wither.

(c) Buffaloes must not be less than 6 years old and must stand 51 inches high at the wither.

Harnessing.—Bullocks and buffaloes require little harness. If collar is used it should just fit the neck. The yoke should be quite smooth to prevent the neck from being galled and any roughness should be removed by rubbing with sand paper or any sharp-edged thing such as broken glass, knife etc.

Shoeing of Cattle.—Shoeing is the attachment of a metal plate to the under surface of the foot to protect it against any extra wear and tear. Animals only require to be shod on all the four legs when they move on hard surfaces and have hard work to do, *e. g.*, drawing or carrying loads, or else they may only be shod on the front two legs which carry the brunt of the weight. In the wild state the growth balances the wear of the hoof, but when domesticated and worked the wear is greater than the growth, hence the need for shoeing. While shoeing, caution should be exercised in not injuring the sensitive structures inside the horny hoof.

Preparation of the Foot for Shoeing.—The nail or hoof grows at the rate of about a quarter to a third of an inch per month and as a result the foot becomes mis-shaped and the shoe projects out. Hence the nail requires to be scraped and the shoe changed periodically. The object for preparing

the foot is to remove all the superfluous growth of the horn so as to obtain a good attaching or bearing surface for the shoe. The shoe should be light, as heavy ones throw greater weight on the legs and fatigue the animal soon ; easily retained and capable of lasting for about a month.

Working bullocks need only be shod on their inner hoofs which carry the brunt of the weight. Two thin plates of iron according to the size of the foot are applied and secured by nails taking care not to drive them into the underlying soft structures.

In *shoeing horses* one must always see that the shoes fit properly, that only good nails are used, the clenches or the turned ends of the nails should, after the animal has been shod, be equidistant from each other and not above an old nail hole ; the nail heads should fit well into the nail holes on the ground surface of the shoe and do not project above the level of the shoe. The clips, which are the projections drawn from the outer and lower border of the shoe should be well made from the body of the shoe and fairly large, strong and not hammered down too tightly. The feet should be sufficiently and proportionately reduced and after shoeing should be of the same length. The shoe should be light and its width must be the same as the bearing or attaching surface of the foot.

CHAPTER II

FEEDING OF ANIMALS

Food is anything, which, when taken into the system, goes to build up and repair the tissues of the body and also to produce energy. The *principles* of feeding are determined by the anatomy of the digestive system and the use to which the animal is subjected, i. e., whether for the production of energy, flesh or milk. The food must suit the requirements ; it must be good, wholesome, plentiful and palatable. It should be properly prepared and given at regular intervals. In short the principle for feeding animals is to obtain the highest result with the lowest possible cost.

The quantity of food varies with the size of the animal and the nature of work it does. The food should be given an hour or so before the animals are taken out for work ; the stomach should not be fully loaded as it would then interfere with respiration. The food should always be given at fixed hours two or three times a day, and any changes in the diet should be gradually introduced. Animals should be watered at least half an hour before feeding. The conservancy animals should be watered at 4 in the morning, provided with food about half an hour later and then taken out for work at about half past five. It takes an animal about half an hour to take its food.

There are various articles of diet but only the principal ones are considered here.

First of all come the *grasses* which are divided into two classes viz :—

(1) the *natural grasses*, i. e., those belong to the Natural Order *Gramineæ* (the grass order) ;

(2) the *artificial grasses*, i. e., plants although not belonging to the grass order yet used for the purposes of common grass. Only one such artificial grass is used in India and this is lucerne, which belongs to the Natural Order of *Leguminosæ* (the legume order). It is very nutritious and makes an agreeable change but is rather difficult to digest. It may be given to an animal from 2 to 4 seers a day as with big quantities tympanitis (i. e. distension of the bowels with gas) is generally brought on.

Grasses.—There are various kinds of grasses in India, but the most common ones are: (1) the *dhoob grass* which is best for forage, very nutritious and makes good hay. (2) The *spear grass* which has long and narrow leaves and makes good fodder if given before the formation of spears, or even after if thoroughly beaten off. (3) *Genawa* which is grown in Bihar makes good forage and hay.

Besides these there are other grasses such as the Guinea, Khus-Khus (*Andropogon Sp.*) etc.

Fresh grass before use should be thoroughly shaken and beaten to free the roots from all mud and stones. It should never be washed as the water removes the nutrition and hastens decomposition. All wet bundles of grasses should be opened out and dried in the sun. Green grass has a cooling effect, increases the flow of urine and relaxes the bowels. The daily ration is from 15 to 20 seers for an average-sized animal and can be substituted for hay when not available. 18 seers of green grass is equivalent to about 5 seers of hay.

Hay or Dry Grass.—*Dhoob* and *genawa* make good hay. Good hay should be greenish brown in colour and when the interior of the bundle is smelt there should be no musty odour. The stalk should be fine and firm and sweet in taste.

Hay is taken as the *standard food* for horses and is given to supply the bulk of food. The average daily allowance is from 7 to 15 lbs., but it depends on the size of the animal and

on the amount of grain given. The best time to give hay is the night when the animals can chew it at pleasure. Grass for hay should be cut when in flowers and just before the seeds are formed, it should then be dried in the sun for 2 or 3 days.

Straw consists of the dried stalks of rice (*Oryza sativa*), wheat (*Triticum sativum*), oats, barley (*Hordeum vulgare*), maize or makkai (*Zea mays*) etc. It is used for fodder as well as bedding for animals. If intended for feeding animals it should be cut before the plant is too old, otherwise it will be innutritious. Oat straw is somewhat short in size but good for horses, while the straw of rice and millet (Joar—*Andropogon Sorghum*) is largely used for feeding cattle. The average daily allowance for cattle is 10 to 20 seers according to size.

Good straw should be long, clean, yellow, not much broken, with a sweet taste and agreeable smell. It is useful for bulk and when chopped short and mixed with grains, *i. e.*, crushed oat (*Pennisetum typhoideum*) or gram (*Cicer auriculinum*) prevents bolting (*i. e.* swallowing without mastication) and induces chewing.

The following are usually called **concentrated foods** as they contain a large amount of nutrition in a very small compass.

Grains.—The principal ones used in India for feeding animals are :—

(1) **Oats.**—They are largely used in Bengal and northern India for feeding horses and are superior to all other Indian grains. They may be given whole but are best given crushed alone or mixed with other grains or straw. The average daily allowance is from 4 to 8 lbs. and when mixed with other grains an equal quantity of oats should be deducted.

Good oats should be at least one year old, plump, short and hard, and rattle when poured into the manger. They

should be sweet and clean and of a golden yellow colour with no earthy or musty odour.

(2) **Gram** (*Cicer arietinum*) is the most common food for horses in India and contains a large amount of nitrogenous or flesh-forming substances. It is very heating and should, therefore, not be given in large quantities. It should be given crushed, slightly damped, i. e., washed in water or soaked only for half to one hour, and mixed with equal parts of oats and chaff. The practice of soaking it for some hours before giving it to animals is to be condemned as it helps the animal to bolt it without mastication and so brings on indigestion, colic and tympanitis.

Good gram should be at least 8 months old as new ones are apt to upset digestion, reddish brown in colour, hard with a pleasant taste and smell and sink in water. When worm-eaten it is quite useless and floats on water.

The average ration is from 4 to 8 seers a day for a horse according to its size and working capacity, 2 seers for a large-sized bull or buffalo and $\frac{1}{2}$ to 1 seer for a working ox.

(3) **Barley** (*Hordeum vulgare*) forms an excellent food if properly prepared and is largely used in Bengal and in the Punjab. It should be parched in order to break its outer covering or husk which is very difficult to digest. When not thus prepared the husks irritate the digestive tract producing colic and itchiness of the skin. It is highly nitrogenous and may be given alone or mixed with bran or gram.

The average daily allowance is from 4 to 8 pounds.

(4) **Maize, Makkai or Indian Corn** (*Zea mays*) is also largely used. It is rich in fat but poor in nitrogenous or flesh-forming substances and is a fair food if mixed with other grains; alone it causes loss of energy although it fattens the animal. For hardworking horses it is no good and causes sweating. It should be crushed or parched and mixed with cut straw to ensure thorough mastication.

The average daily allowance is from 2-4 lbs. along with other food.

(5) **Wheat** (*Triticum sativum*) is very indigestible and should not be given to horses. If no other grain is available it should be well parched before being given.

The daily ration is from 2 to 4 pounds.

Bran or Bhusa is the outer covering of wheat. As compared with mill-bran *chakki* or hand-made bran contains a large amount of flour due to imperfect grinding. It is an ideal food for horses, being rich in nitrogenous materials. Bran should form part of the feed of all animals as it gently stimulates the liver and bowels. Good bran should be free from dust and have a pleasant odour and yellow tinge, and when rubbed between the fingers should whiten them slightly with the flour it contains. Fraudulent dealers often adulterate it with sand or saw dust. It should not be given in large quantities as it is liable to ferment and produce flatulence.

The daily ration is from $\frac{1}{2}$ to 2 seers.

Bran Mash is an excellent ordinary sick diet and is also beneficial for hard-working animals, especially horses. It is prepared by sprinkling 1 or 2 seers of bran in some (about 4 gallons) boiling water till it becomes quite soft and adding one chittack (2 ounces) of salt. The mash is then covered up and given to sick animals when cool both in the morning and evening and to hard-working horses only once a week.

(6) **Rice or Paddy** (*Oryza sativa*) is largely used in Burmah for feeding animals. It contains a large amount of starch but is deficient in fat and nitrogenous substances and so requires to be combined with bran or gram. It is an useful sick diet for cattle and given as rice *kunji* or *gruel*. Rice forms a thick cake in the bowels of horses even if masticated. It should be given with husk in order that horses would masticate it and also for stimulating the bowels.

The average daily allowance is from 4-8 pounds.

(7) **Kulthi** is a variety of Moong (*Phaseolus mungo*). It is the chief feeding grain in the Madras Presidency. It should be boiled for about 2½ hours and then given by mixing with chaff to prevent bolting.

Kulthi (a species of *Phaseolus mungo*), *Moong*, and *Urid* (*Phaseolus radiatus*) are very much alike in their nutritive value and used both for horses and cattle but they should always be given boiled.

The average daily ration is from 2-4 lbs.

(8) **Jower** (*Andropogon sorghum*) and *Bajra* (*Panicum sp.*) are flesh-forming and fat-giving grains. The daily ration is from 10 to 15 lbs according to the size and amount of work done by the animal. They should always be given crushed.

(9) **Linseed** (*Linum usitassimum*) is given occasionally as part of the feed being very useful for animals which are out of condition or convalescent. It produces a smooth glossy coat and should only be given in small quantities in order to prevent the relaxation of bowels. For weak and debilitated animals ½ to 1 lb of linseed boiled for 3 to 4 hours in a lot of water and mixed with about ½ lb. of bran and a little salt should be given daily when cool and continued until the bowels do not relax and the condition improves.

Linseed meal or crushed linseed is added to the food of animals. Linseed oil can also be given.

Linseed tea is prepared by boiling ½ seer of linseed in a gallon of water for 2 hours and then strained and given to the animal after mixing with a little salt.

Oil cakes are the residue left after the expression of the oil from various seeds—the principal ones being linseed, (*Linum usitassimum*), mustard (*Brassica juncea*) and ground nut (*Arachis hypogea*). Oil cakes are of high feeding value especially for milch cows being rich in oily substances and

producing butter. Linseed oil cake is superior to others and used for feeding cattle ; horses do not require it. Mustard oil cake can be given to working bullocks but not to milching cows as it spoils the milk by imparting a mustard-like odour to it. It should not be given moistened with water as this sets up fermentation, but spread in small lumps on the top of the food. The average daily allowance for cattle is from $\frac{1}{2}$ to 1 seer.

Roots.—Those generally used such as carrots (*Daucus carota*), turnips (*Brassica rapa*), radishes (*Raphanus sativus*), etc., are very good for horses and also for sick and convalescent animals. They help the regular action of the bowels, increase the flow of urine and are a skin tonic. They should be sliced before being given to the animals to prevent the obstruction of the gullet or food-pipe.

Feeding Cattle (Buffaloes, bulls etc.).—The cattle are generally fed twice a day, *i.e.* morning and evening. Bulk is important in feeding cattle as their stomach is of large size. The daily amount of food necessary for an ordinary-sized working bullock is as follows :—

Gram	...	...	1 $\frac{1}{2}$ seers
Mustard oil cake	...	...	$\frac{1}{2}$ seer
Bran	...	...	1 seer
Chaff	...	...	2 seers
Straw or hay	...	...	6 seers (to ensure bulk, the strips of straw should be 3" to 4" long.)
Salt	...	...	1 chitack
Water	...	...	<i>ad libitum</i>

Divide the ration into two meals for morning and evening.

Reduce straw proportionately in case of natural grazing.

Idle bullocks should graze all day long or else have 8 seers of green grass or 10 seers of straw but no grains.

The following is the daily scale of food for conservancy animals employed by the Corporation of Calcutta :—

Articles of food	Pony		Bull		Buffalo	
	Seers	Chitacks	Seers	Chitacks	Seers	Chitacks
Gram	1	12	1	12	2	4
Bran	...	7	1	12	2	4
Oats	...	14	...	...	...	...
Barley	...	7	...	...	...	...
Straw	3	...	4	...	6	...
Hay	4	...	...	...	...	...
Salt	...	$\frac{1}{2}$	...	$\frac{1}{2}$	...	$\frac{1}{2}$

Cost of food for a (1) Pony ... /8/-
 (2) Buffalo ... /7/-
 (3) Bull ... /5/- } per diem.

Sick Diets.—The object of sick diets is to give nourishment with easily digestible food. All sick diets should be tempting.

The following sick diets are most commonly used :—

- (1) *Rice Kunji* is prepared by boiling rice quite soft in water and made into one mass by stirring and then a little salt is added to it. It should be given when there is diarrhoea up to 2 seers a day.
- (2) *Linseed tea*—see before.
- (3) *Linseed gruel*—the linseed is to be boiled for about a couple of hours.

- (4) *Suttoo* (*Hordeum vulgare*) *gruel* is very good for animals suffering from diarrhoea and made by adding water to *suttoo* so as to make a thick liquid. Salt should be added before giving it to animals which should be fed several times a day.

The average daily ration is about 4 seers.

- (5) *Bran Mash*—see ante.
- (6) *Scalded Oat* (*Avena sativa*, Linn.) prepared by taking 1 seer of oats and pouring about a seer of steaming water over it. Infuse for some time, strain and reject the water and then give the oats to the animal.
- (7) *Hay tea*.—To prepare it, take clean hay, cut into small pieces and add steaming water ; infuse for about 15 minutes, strain and give the water to the animal to drink when cool after mixing with a little salt.

Besides these sugarcane (*Saccharum officinarum*, Linn.), fresh bamboo leaves (*Bambusa sp.*), etc., are also used as sick diets.

CHAPTER III.

REST AND WORK

Exercise or work is essential for the health of animals but its amount depends upon the constitution, strength and age of the animal as well as on the quality and quantity of food given and also the season of the year. Slow work at a cart, as in the case of scavenging ponies, and bullocks which do work at a walk, may last for 8 hours or more in a day.

Labour should be just short of fatigue. Animals can work hard in winter ; buffaloes do hard work in the rainy season and in winter, but in summer they become awfully thirsty and heated as their black coat absorbs much heat.

Animals should be given water to drink half an hour before a meal and then given rest for an hour or so before taken out for work. Bullocks take about 1 to $1\frac{1}{2}$ hours to eat their food. A horse does very well without washing but grooming is always necessary.

Buffaloes should be bathed twice a day and should get less work in summer. In summer afternoons the animals should be taken out for work at 4 P.M. Bullocks do not require frequent washing but they must get enough drinking water after return from work. The feet and hoofs of all the animals should be properly cleaned after their return from work.

CHAPTER IV

MINOR AILMENTS

The common accidents and diseases that are to be met with among cattle are :—

- (1) Neck or yoke galls.
- (2) Broken horns.
- (3) Displacement of patella or knee-cap.
- (4) Dum Dum sore or warty growths on the neck of buffaloes and bullocks.
- (5) Sprains.
- (6) Wounds.
- (7) Abscesses.
- (8) Colic.
- (9) Tympanitis or hoven.
- (10) Choking.
- (11) Diarrhœa.
- (12) Sunstroke.

(1) **Neck or Yoke Galls.**—These are wounds resulting from the friction of badly fitting yoke. These vary from simple bruise or sore to the formation of new tissues. The part becomes red, swollen, hot and painful. If the swelling is not reduced in the early stage by the application of cold douche or compress, matter or pus forms in it. If the animal is still worked and the friction continued new tissues grow.

Treatment.—The animal should be given rest. In the early stage, when the part swells and becomes painful, cold water bandages or douche would help to reduce the swelling and lessen pain. But when pus forms it should be incised by a knife previously sterilised by boiling or by passing a few

times through a flame. The cavity should then be cleaned and washed with some antiseptic lotion, *e.g.*, perchloride of mercury lotion (1 in 1000) or phenyle or cyllin solution, and bandaged. The opening should not be closed but allowed to remain for draining the cavity. When the new tissues grow and the part becomes hard, blister with red iodide of mercury ointment (1 in 8-12) every third or sixth day according to the urgency of the case. If not successful a veterinary surgeon should be called in for the removal of the tissues or growth by knife.

The wounds can also be treated by the application of a powder prepared by mixing powdered chalk (4 ounces), charcoal (1 ounce), alum ($\frac{1}{2}$ ounce) and sulphate of copper ($\frac{1}{2}$ ounce). Application of salt solution over the neck hardens the skin and the irritation then produced by the yoke is not so acutely felt.

(2) **Broken Horns.**—These result from the careless throwing of the bullock or buffalo at the time of shoeing or rashly driving an animal against any hard object. It varies from a simple crack to complete division with loss of skin. In simple cracks apply a tarred bandage (*i. e.* a bandage 4" wide and 6' long thoroughly coated with tar) with some clean tow firmly to keep the cracked parts quite steady and to prevent the admission of the outside air and so affecting the structures underneath.

When the horn is completely broken and the skin covering it is torn exposing the soft structures within, the best thing to do is to remove the broken horn by sawing through it. Any bleeding that may occur should be stopped by cold application, or if necessary by touching the bleeding points with a dull-hot iron and then dressed antiseptically. Substances like the tincture of perchloride of iron or powdered sulphate which stops bleeding may be applied before bandaging.

The after-treatment consists in keeping the wound quite clean by syringing it daily with any antiseptic lotion, *e.g.*, perchloride of mercury (1 in 2000) or carbolic lotion (1 in 100), to prevent the underlying structures from being affected as the horn communicates with the nostril through holes, until the sore heals up. Permanganate of potassium solution or decoction of *neem* (*Asadirachta Indica*, Jussien; *Melia asadirachta*, Linn.) leaves may also be used for washing the wounds.

(3) **Displacement of Patella.**—The knee-cap or the patella slips out of its position (*i. e.* the stifle joint) when the animal yoked to a cart moves upon uneven surfaces. The limb goes back and the toe touches the ground. The animal goes lame and drags the foot as it goes.

The *treatment* consists in replacing the patella into proper position by gentle and steady pressure of the palm of the hand and giving rest to the animal for about a month. The displaced bone can also be set back by making the animal swim. The affected part and its surroundings should be blistered with red iodide of mercury ointment (1 in 12) to ensure proper rest. The displacement is apt to recur and the animal may not afterwards be fit for heavy cart work.

(4) **Dum Dum Sore.**—These are peculiar small warty growths which appear on the upper part of the neck of cattle, chiefly in Bengal. The disease is particularly prevalent in Calcutta and Dum-Dum, hence the name. Their exact nature is not known but they are troublesome and difficult to cure. They usually originate from dirt and spread from one animal to another chiefly through the agency of crows.

Treatment.—Remove all growths by a flat dull-red firing iron and subsequently apply carron oil prepared by thoroughly mixing equal parts of lime water and any bland oil, *e. g.*, linseed oil, cocoanut oil, olive oil etc., for about a week and then paint the part with tincture or liniment of

iodine according to the nature and severity of the disease. These cases are very obstinate and the treatment may be repeated three or four times according to the urgency of the case. The sore should always be kept properly covered to protect it from crows or flies.

(5) **Sprains.**—These consist of injury to or rupture of the ligaments—*i. e.* the binding structures—around the joints, muscles and tendons without dislocation of the bones. The tendons most liable to sprain in horses and cattle are the back tendons of the foot, and the ligaments are also the back liga-

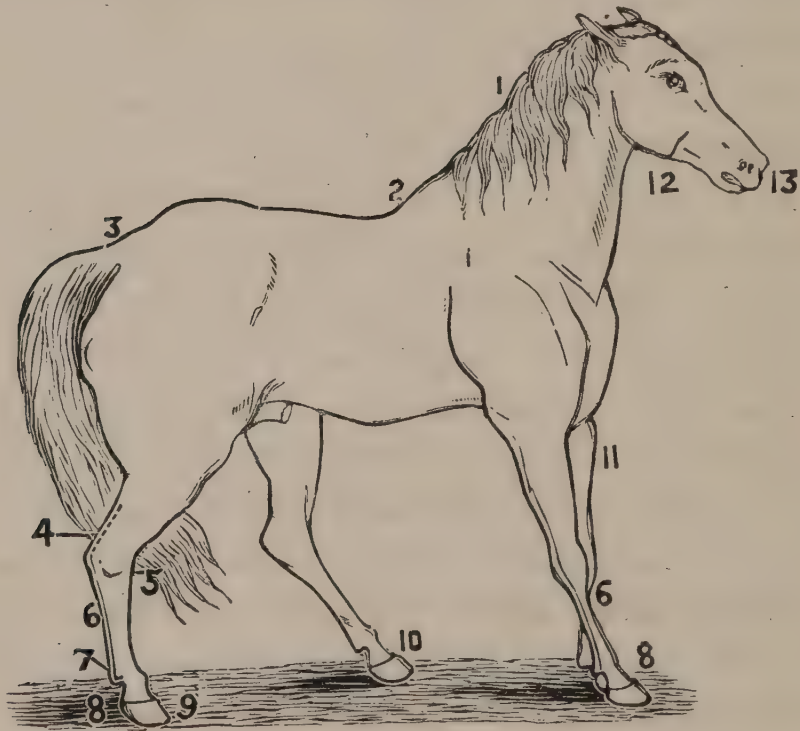


Fig. 36. Horse with names of parts: 1—crest; 2—withers; 3—croup; 4—hamstring; 5—hock; 6—cannon; 7—fetlock; 8—pastern; 9—hoof; 10—coronet; 11—arm; 12—gullet; 13—muzzle.

ments of the foot and fetlock joints. The muscles most liable to sprain are those of the thigh and hip. Sprains are usually caused by injury or by the animal's falling in a ditch or hole. The symptoms are pain, lameness with heat and swelling of the affected part.

Treatment.—At the outset apply cold water over the affected area. Arnica lotion or Goulard's lotion mixed with

a little opium, as in the following prescription, can with advantage be applied in the early stage to lessen pain.

Take of :—

Sugar of lead (lead acetate)	...	2 drams
Tincture of opium	...	2 drams
Water	...	1 pint

Make it into a lotion and apply continually over the painful area by moistening a pad of clean rag with it.

Give rest to the animal and remove shoes, if any.

When the acute symptoms pass away, *i. e.* when the heat subsides but the swelling of the part remains, apply a blister of red iodide of mercury (1 in 8-16 according to the necessity of the case) which should be kept on for about 6 hours. If no benefit is derived from one blister another may be applied after a month. Firing is also good for chronic sprains of ligaments and tendons.

(6) **Wounds.**—These are generally caused by badly fitting saddles, falls, treading on sharp and pointed objects, blows from blunt objects and instruments etc., and usually involve the muscles and tissues beneath.

Treatment of wounds.—A clean cut wound generally heals up by the union of its edges when these are held together either by stiches or by tight bandages. When the edges cannot be so approximated the wound heals up by granulation, *i. e.* by forming new tissues from the bottom and sides. A healthy or granulating wound should be of flesh (*i. e.* bright pink) colour without any matter discharging from it and with a whitish edge surrounding it. Nature repairs a wound when it is kept thoroughly clean. Bleeding should be stopped by tight bandaging above and below the wound, or by applying a pad soaked in carbolic or perchloride of mercury lotion on the bleeding spot and bandaging it firmly and evenly. Dull-hot firing iron may also be applied to the mouths of the divided vessels to stop bleeding, while large

vessels may be compressed by pressure forceps. The wound itself should be cleaned with some antiseptic lotion, dusted with boracic acid and bandaged up after covering it with some clean or sterile tow, cotton wool or rag. The surrounding of the wound should also be washed clean with soap and warm water.

When a wound is neglected it becomes fly-blown with the result that maggots or grubs form in it. In such a case the wound puts on an angry appearance, and if its bottom is carefully examined the movements of the maggots or bubbling on the surface can be observed. The maggots should be removed by forceps and oil of turpentine applied to the wound.

(7) **Abscesses.**—These are collections of matter or pus beneath the skin or muscles caused by germs or micro-organisms. An abscess generally arises from a bruise or other injury and its formation is always attended with increased heat, pain and swelling. Whenever matter is forming the part around becomes greatly inflamed and swollen and the abscess becomes more or less localised. When the abscess is fully formed or ripe, it comes to a head and becomes soft to the touch.

The *treatment* consists in continually fomenting or poulticing the part to soften the skin so as to enable the matter to press its way easily. When it ripens it fluctuates and can then be incised at the softest and most prominent part with a clean knife. When opened cease fomenting and treat it as an ordinary wound.

(8) **Colic** is any pain in the abdomen. It is of two kinds, *viz.*, spasmodic and windy or flatulent colic. It is common in horses, rare in cattle.

The attacks of colic are always sudden and the causes generally are giving cold water to drink while the animal is warm and perhaps covered with sweat, overeating, improper feeding and costiveness.

The *symptoms* are pain in the belly, restlessness, constipation, or diarrhoea if the animal is fed on fermented food or fed improperly, and ineffectual efforts to urinate. If the pain is severe the animal looks to the side of the belly and moves in a circle and even kicks his belly with his hind feet.

Treatment.—Foment the abdomen and give an enema of soap and warm water or a purgative combined with Indian hemp (*Cannabis sativa*), tincture opium (1—1½ oz.) or belladonna. Starve the animal for a day or two and when the animal is convalescent give the following tonic mixed with the food daily :—

Aniseed (*Foeniculum Vulgare*) ... 3 drs.

Chiretta (*Swertia Chiretta*) ... 1 oz.

Cardamom (Elaichi) (*Amomum Cardamomum*) 3 drs.

Omün (Ajwan) (*Ligusticum Ajwan*) ... 3 drs.

In mild forms of flatulent colic thirty drops of oil of pimento in half a pint of thin gruel and repeated every 4 hours may be given with advantage.

(9) **Tympanitis or Hoven**.—It is the distension of the first stomach or rumen with gas caused by the fermentation of food in it generally due to feeding the animal improperly or irregularly, *e.g.*, on rotten and decomposed food, such as oversoaked gram, bran, oil cake, large quantities of green grass etc., or from want of tone of the stomach walls. The swelling is noticeable on the left flank and gives a hollow or drum-like sound when tapped with fingers. The animal remains standing as it feels pain on lying down, becomes very uneasy, pokes its head straight out, does not feed or ruminate, kicks its belly and grunts from pain. There is difficulty in breathing which becomes more and more marked as the distension of the belly becomes greater until at last the animal falls down and dies of suffocation. In acute cases the duration of the disease may be from one to three hours, while in others 8 to 12 hours.

Treatment.—Give as soon as possible one ounce of turpentine or a dram of carbolic acid with a pint of linseed oil to stop fermentation. Starve the animal for a day or two. Foment the belly and remove all rotten substances from the stomach by a purgative, such as half a pound each of magnesium sulphate and common salt, one ounce of ginger (*Zingiber officinale*) with 4 or 5 pints of warm water, or give an enema of soap and warm water. In bad cases a veterinary surgeon should be summoned.

The animal after recovery should be fed with a little green grass but on no account should large quantities of food be given. When one animal is attacked the rest should be prevented from over-eating.

(10) **Choking**—It is called *Rokgalla* in Hindi and caused by the blocking up of the food-pipe or gullet by hard and large pieces of food, such as sugar-cane (*Saccharum officinarum*, Linn), turnip (*Brassica rapa*, Linn.), onions (*Allium cepa*), etc. The obstruction may be in the back part of the throat or in any part of the wind pipe. If it is in the throat the animal coughs violently and there is copious flow of saliva from the mouth, and when the animal drinks water it comes out through the nostrils. If the obstruction is in the food pipe inside the chest the water at first goes into, but soon returns through the nostrils and mouth and the impacted mass may be seen or felt. The animal is very uneasy and shows signs of distress.

The *treatment* consists in the removal of the obstructing mass by the hand, if it is in the throat. If in the food pipe give carefully a pint of warm ghee or linseed oil or any bland oil; if it answers, give gruel or mashes for 3 or 4 days; if not, call in a veterinary surgeon.

(11) **Diarrhœa** or looseness of the bowels is known as *Petnabano* or *Pater Ausook* in Bengal, *Bhowknee* in the Punjab and *Dast* in Hindustani.

In this disease there is frequent and inordinate passing of watery motions, sometimes streaked with blood, with or without griping. It is usually caused by the ingestion of unwholesome forage, acrid herbage or foul water. It may also be due to exposure to great heat, or to the presence of intestinal parasites.

It is not always necessary to give medicine. Remove the cause, change the diet and water and the symptoms may disappear. If it is due to errors of diet give a mild purgative such as 10 ounces of castor oil with 6 ounces of linseed oil and repeat if necessary. In severe cases the animal should be fed only with rice gruel, and if there is much pain the abdomen should be fomented and the animal given an ounce of subnitrate of bismuth night and morning either alone or mixed with 1 to 2 drams of powdered opium.

It is important to feed the animal with food like boiled rice and other demulcents that will be easily digested and soothing. Bamboo leaves are good.

The stools should be carefully examined for intestinal parasites or their eggs, and if any is found the animal must be given something that will kill the worms, *e. g.*, 2 ounces of oil of turpentine with a pint of linseed oil, after starving it for about 12 hours.

(12) **Sunstroke.**—This is due to pressure of the collar or harness, or hardwork under hot sun during damp and muggy weather.

The *symptoms* are: a sudden reeling gait and the animal generally falls down, frequently quite paralysed.

The *treatment* consists in protecting the animal from the sun and in applying cold water or ice to the head and spine. The animal is to be kept as quiet as possible. When the animal comes round, give a purgative and soft food for a few days.

CHAPTER V

PREVENTION OF INFECTIVE DISEASES

An *infective disease* is one which can be transferred from one animal to another either by direct contact, or by inoculation, or through food or drink. It is due to the action of certain disease-producing germs or micro-organisms which have the power of invading and multiplying upon living tissues, especially when they are injured or their vitality is lowered. The smallest living plants known as *bacteria* and the smallest living animals or *protozoa* are the chief cause of the infective diseases. When these disease-producing organisms or microbes get into the body they begin to grow there and produce a poison (called *toxin*), and it is this toxin circulating in the blood and carried to the various parts of the body causes the symptoms of disease such as fever, etc. To counteract this toxin or poison, the cells or the smallest living units of which the body is composed, form a substance known as *anti-toxin* which neutralises or destroys the toxin.

The majority of the disease-producing germs belong to the vegetable world and comparatively few to the animal kingdom. Animals which are proof against an infective disease are called *immune* to that disease, while those that are predisposed to certain diseases are called *susceptible* ones. Thus for example the cattle are susceptible to rinderpest but immune to glanders, while the reverse is the case with horses.

Prevention and Repression of Infective Diseases.—The prevention of infectious diseases is of very great importance, as it not only aims in protecting the animals from the invasion of the disease-germs but also in preventing the development of the disease after the

germs had gained admission into the system. Various preventive means,—*e.g.*, hygienic measures, medical prophylaxis and immunisation,—are adopted, but of these the last named one is the most important and may be attained in two ways : (1) by inducing a modified form of the disease, and (2) by injecting anti-serum. Immunity obtained by the first method is of long duration, while that by the second one is of short duration—lasting only for a few weeks to perhaps as many months.

Repressive measures become necessary when an outbreak of any infective disease, especially of a dangerous nature, appears in a locality. All such measures should be very prompt and energetic in order to control and stamp out an epidemic. The repressive measures consist principally of (1) notification, and (2) isolation or segregation.

The last named measure is very effective when properly carried out. To do this the animals should be divided into three lots, *vis.*, the affected, the suspected (*i.e.* the contacts) and the healthy, and each group along with its attendants, watering and feeding utensils, clothing, bedding, etc., should be kept separated for about three months or until all danger is over. The distance between the different groups should if possible be considerable (about 200 or 300 yards) so as to exclude the chance of any communication, and if there is a prevailing wind the healthy should be placed to the windward and the suspected and the sick to the leeward side. In rural areas where ample land is available the best thing to do is to allow the sick to remain in the infected area and to remove all others at a reasonable distance outside the village on some dry suitable spot. The place or shed where the diseased animals are located should be enclosed by a strong fence, and no forage, water, litter, clothing, etc., should be taken outside the fence. Dogs should not also be allowed to go to the place as they may carry the infection to the place where the healthy stock is kept. Animals

that recover should not be allowed to pasture or to be kept with the healthy ones until three months expire after the last case of disease had occurred among the affected lot. In an outbreak of rinderpest, when the anti-rinderpest serum is available, all the animals should be injected with it and this will at once suppress the disease by immunising or raising the resisting powers of the susceptible animals. In such cases isolation or segregation will not be necessary, and the protected cattle should be allowed to mix freely with the sick so that natural immunity may supervene.

Cleansing and Disinfection of Stalls.—Strict cleanliness of lines, gear, watering vessels, feeding boxes and bags, and personal cleanliness of the attendants is in itself a good safeguard against the spread of any infectious disease. Any site or building, poles of carts, harness, clothing, utensils or other articles used by the affected animals should be thoroughly disinfected, and all articles of small value such as the old lining and stuffing of pack-saddles, ropes, baskets together with discharges from the eyes, mouth, nostrils and bowels should be burnt down. The best time for carrying out the disinfection is when the animal is dead or convalescent. During the prevalence of the disease the floor of the stall or shed should be scrupulously cleaned daily by frequent sweeping and washing, and after every cleansing disinfectants should be freely used. After the animals have been removed all dung, litter, refuse food, etc., from the stable or shed should be collected and burnt within the infected area. The walls should be scraped and all scraping should be treated similarly. The floor, if *kutchra*, should be dug up to a depth of 6 inches or more, according to the nature of the disease and soil, and the earth so removed buried. Then remake the floor with clean earth and whitewash the walls with slaked lime.

If the floor is *pucca*, i. e. of masonry, it should be scrubbed clean of all dung, discharges, etc., and then thoroughly washed

with some antiseptic lotion, such as perchloride of mercury (1 in 1000), cyllin (1 in 200), chloride of lime (1 in 30), etc. All doors and windows may be treated in the same way or painted with boiling tar. Iron utensils should be disinfected by thoroughly washing with cyllin or phenyle lotion. Earthen vessels must be destroyed and wooden ones thoroughly cleansed and disinfected. The doors and windows of the infected shed should be kept open for a month or so in order to allow the natural disinfectants, viz., the sun and the air, to play their part. Sheds or huts which are made of straw and can be readily constructed at a very small cost should better be disinfected by fire when vacated by the sick animals. All clothing belonging to the patients and attendants should be thoroughly boiled for an hour or soaked in some disinfectant solution for a few hours. All convalescent animals should be well washed with warm water and soap or in some weak antiseptic lotion, such as carbolic, phenyle or izal, prior to their removal from the infected shed.

Common Disinfectants.—The *disinfectants* (*i. e.*, substances that destroy disease-producing germs) most commonly used are :

Perchloride of mercury lotion (1 in 1000) prepared by taking half an ounce of corrosive sublimate, one ounce of strong hydrochloric acid and three gallons of water. This is very efficient and cheap as it costs only a few annas. It should be kept in glass, wooden or earthen vessels as metal ones are corroded by it. A little colouring material, such as a grain of aniline blue, is usually added to the lotion in order to give it a distinctly blue tint that cannot be mistaken to prevent accidental poisoning, as ordinarily the solution is as colourless as water. The hydrochloric acid is added to overcome the relative inertness of the perchloride in the presence of albuminous substances such as dung, blood, etc.

Carbolic acid lotion (1 in 20 or 40) is prepared by simply

dissolving carbolic acid in water. *Phenyle* is also used and a good sample of it should be about double the strength of carbolic acid. By far the best is *cyllin* which is cheap and is about 17 times more powerful than carbolic acid. Leather articles can best be disinfected by wiping with *formalin* lotion. Advantage should always be taken of steam disinfectors, if there be any owned by the municipality, for disinfecting all infected articles. *Moist heat or steam* is more efficient than dry heat. If nothing is available handy, boil those that can be boiled, and disinfect the floor and everything else by *fire*. To treat the floor with fire cover it with a layer of dry cowdung cakes or charcoal and then set fire to them, taking care that the fire does not spread on to any inflammable fitting, etc.

All animals, whether healthy or suspected, should be inspected daily and any showing the slightest symptoms of disease removed and isolated at once. The sick should be kept scrupulously clean and have green grass, thin rice gruel and other sick diets according to the nature of the disease. The healthy cattle should also be kept on soft and laxative food as cattle fed on hard dry food get the disease in a more aggravated form than those fed on laxative fodder.

All newly purchased animals should be looked upon with suspicion, as diseases like the rinderpest and foot-and-mouth disease are always present more or less everywhere in India. They should, after their purchase, be kept by themselves and not allowed to mix with the old stock in the Gowkhana, and so kept for about three months in order to have proof afforded whether they are affected with any infective disease or not. The reason for this long isolation is that diseases like rinderpest or cattle plague, anthrax, foot-and-mouth disease, hæmorrhagic septicæmia and black quarter have a period of incubation for about a month, while in others, like pleuro-pneumonia, it may be as long as three months. The term *incubation period* may be defined as the length of time

that elapses between the entrance of the poison or disease germs into the system and the first appearance of the symptoms of the disease ; during all this time the poison develops and multiplies in the system.

Carcasses of animals that die from any infectious disease should, whenever possible, be burnt whole on the spot where the animals died. If this cannot be done owing to lack of fuel they should be buried in a bed of lime in pits 5 or 6 feet deep dug in isolated places.

CHAPTER VI

INFECTIVE DISEASES OF CATTLE

The following are the common infective diseases that are to be met with among the cattle :—

- (1) Rinderpest or cattle plague.
- (2) Foot-and-mouth disease.
- (3) Anthrax.
- (4) Hoëmorrhagic septicæmia, and
- (5) Black quarter.

Every Sanitary or Conservancy Inspector should make a special study of the abovementioned diseases as all the municipalities employ cattle for removing refuse. Each one of these diseases is known under different vernacular names in different provinces and even in the different parts of the same province. These diseases are not only directly communicable from one animal to another, but the contagium or the disease-producing poison may be carried by the attendants going from the sick to the healthy, or may even be carried with forage or water. Moreover a stall or ground occupied by a diseased animal becomes also contaminated by contagium present in its various discharges.

RINDERPEST.

Synonyms :—Basanta (Bengal) ; Chichuck (Behar) ; Goo-tee (United Provinces) ; Manuan and Sitlah (Punjab) ; Matah, Pitchinow (Madras) ; Peya (Bombay), etc.

It is a very fatal and highly infectious disease of the typhoid type and is characterised at first by fever, increased redness of the lining membrane of the mouth, diarrhœa and then dysenteric stools mixed with blood. It affects all animals,

domestic and wild, which chew the cud, but the bovine species (*i.e.*, the bullock as a class) is more liable to it. This disease is more prevalent during the spring than in any other season and depends upon the presence of an invisible and specific poison which inhabits the blood and tissues.

The average period of incubation is from 4 to 10 days, but it may be as long as three weeks which, however, is rather very uncommon.

The disease runs a definite course which cannot be cut short by remedial measures. As a rule one attack of it renders the animal immune for several years against a second one. The duration of the disease is from 24 hours to 12 or 16 days but generally 3 to 9 days.

The *symptoms* vary considerably in different outbreaks as well as in different individuals according as the attack is severe or mild. The first appreciable symptoms appear about two days after the onset of the fever.

At the outset the fever comes in with shivering accompanied by spasmodic twitchings of the muscles of the neck, chest and hind quarters and costiveness, but in a day or two a peculiar foetid diarrhoea supervenes followed by a fatal dysentery. The evacuations are watery and mixed with mucus and blood, so that the faeces look black or tarry, and have a peculiar foul smell. The lining membrane of the mouth is at first only congested and hot and rumination becomes slow, but in a day or two peculiar ulcers appear coated with yellowish or bran-like deposits chiefly on the lower surface of the tongue. Sometimes eruptions appear on the skin about the dewlap (the loose fold of skin hanging from the undersurface of the neck), inner side of the thighs and lower part of the abdomen. This eruption is considered to be a favourable symptom. In the early stage the temperature rises to 105°F to 108°F , but when dysentery sets in and the patient becomes exhausted it goes down below normal.

In this stage the pulse becomes almost imperceptible, the eyes have a sunken and dull appearance, there is great prostration, the back is arched and very tender and the animal lies down with the head turned back to the flank, moans, breathes with difficulty and grunts, and finally the end comes on from exhaustion usually between the 4th and 7th day after the first elevation of temperature. Among the most noticeable symptoms of the disease which would at once attract the attention of the conservancy officer on his first entering the Gowkhana will be the viscid discharges from the eyes, nostrils and mouth, twitchings of muscles (in early stages), tarry coloured stools (*i.e.*, fæces mixed with blood and slime in advanced cases), and much prostration,—the animal being unable to stand any longer lies down moaning and grinding its teeth in pain, and stoppage of rumination.

The mortality among the affected averages from 40 to 60 p. c., and in hill cattle the disease is so virulent that cent percent dies. A high mortality also results in Assam and Burmah and also among Sindhi cattle.

Treatment.—As this disease runs a definite course, which cannot be cut short by medicinal treatment, always try to maintain the animal's strength by good feeding so that it may throw off the disease. The affected animal should be kept in a dry, well-lighted and well-ventilated place and the diet should consist of rice gruel—well boiled and of good consistency, or *suttoo* gruel, the former being especially useful for controlling diarrhoea. Water should be given so long as the bowels remain costive. During the later stages when the animal becomes weak and the diarrhoea and griping severe give the animal country spirit (arak or sharab) 2 ounces, Cannabis Indica or Indian hemp (*Bhang*) $\frac{1}{2}$ dram, camphor (*kafur*) one dram, gallnuts or *Majuphal* one dram, made into a draught with gruel twice a day. Give also decoction of bael *ad libitum*; *esabgool* (Spogel seeds) and *indrajab*, or

kurchee seeds (*Wrightia antidysenterica*) two ounces of each, may also be given with advantage. But by far the best thing to do is to inoculate the affected cattle with the curative serum.

Prevention.—When the disease appears very prompt and energetic measures to suppress it after the method mentioned before should be taken. When the anti-rinderpest serum is available all the susceptible animals should be injected with it under the skin just in front of the elbow. The dose should be regulated according to the breed, susceptibility and size of the animal, as well as to the nature (*i.e.* severity or mildness) of the epidemic and the standard (strength) of the serum. For an ordinary-sized animal the dose is about 5 c. c., while double of this dose is to be injected if the animal is of bigger size (*e. g.*, Hissar bullocks or buffaloes); Sindhi cattle would require about 4 times whereas English and other imported cattle about 18 times as much. The serum should not be kept open and should be protected from light and heat, and used always with antiseptic precautions. After injection no segregation will be necessary and the animal can be worked as this does not cause fever. The protection thus afforded lasts for a season only.

FOOT AND MOUTH DISEASE.

Synonyms :—Aishoo (Bengal), Khoorpakha (United Provinces), Mukhur (Punjab), Khoorwa (Bombay) and Moopaung (Madras).

It is an acute infective disease characterised by vesicular eruption in the mouth and feet, and in cows also on the milk gland or udder and teats. It affects chiefly the bovines, *i. e.*, buffaloes, oxen, cows, etc., and even man has become affected from drinking the raw milk of cows suffering from the disease. It is present more or less in all parts of India throughout

the year and one attack of the disease confers immunity against another only for a few months.

It is always due to infection. The specific poison of the disease has not yet been discovered but the virus is generally carried by the cattle themselves, but other animals and man may be the media. The contagium may also be brought with fodder from an infected place.

The period of incubation is from 24 hours to 4 or 5 days but the average period is from 36 to 48 hours.

The *symptoms* first noticed are a rise of temperature, shivering, hot mouth and extremities, with smacking of lips and salivation. The animal does not feed and grinds its teeth. The coronates (or the upper part of the foot at the junction of skin with the hoofs) and the foot itself may be hot and painful; the animal goes lame and not inclined to move about, or lies down persistently. It frequently lifts up its affected foot and shakes it in the air. This condition lasts for a day or two and then vesicles or blister-like eruptions about the size of a bean appear in the space between the digits of the feet, in the mouth and in cows on the udder and teats. The eruptions in the mouth are situated on the gums, dental pad (*i. e.*, the portion of the upper jaw where there is no incisor tooth), inner surface of the lips and cheeks, and the upper part and the tip of the tongue which often becomes raw-looking. These vesicles soon burst leaving raw red surfaces which heal up readily.

Generally the foot and the mouth are affected but sometimes the eruption may appear in only one of these situations. In neglected cases, *e.g.*, if the animal be a bullock and kept at work, the symptoms aggravate and the legs swell, and abscesses and sinuses may form and the hoofs may come off eventually.

Diagnosis.—Foot-and-mouth disease is sometimes liable to be mistaken for rinderpest, but in the former disease

diarrhœa is not one of its symptoms, whereas diarrhœa and dysentery are the invariable accompaniments of rinderpest. Again in rinderpest the feet do not become affected, and the eruption in the mouth appears on the lower surface of the tongue and is covered by branlike deposits which are absent in foot-and-mouth disease.

If the animal is properly cared for the fever disappears in 3 or 4 days and it recovers in 10 to 15 days with little loss of condition. But when neglected complications as stated before are liable to occur and death from blood poisoning usually takes place in 10 to 12 days. The mortality is seldom more than 2 to 3 per cent.

Treatment.—The animal should be put in a well ventilated, clean and dry place and given plenty of water in which some borax or nitre (half an ounce to a pint of water) has been dissolved. The feet must be washed twice a day and kept clean and dry and should better be bandaged up to prevent flies from blowing the sores. One part of camphor mixed with 4 parts of sweet or cocoanut oil may be applied to the sores on the feet, or equal parts of powdered alum and charcoal may be applied as a dusting powder after the ulcers have been cleaned of all dirt. In large outbreaks, where it may not be practicable to individually dress and bandage the feet, the affected animals should be made to walk both in the morning and evening through a specially constructed trough containing some antiseptic or astringent lotion, such as that of phenyle, alum, borax, decoction of *babla*, *neem*, etc.

Throughout the treatment the diet must consist of only soft green grass, and an abundance of thin rice gruel to which, one or twice a day, two or three ounces of treacle and one ounce of common salt may be mixed with advantage.

The measures recommended for the prevention and suppression of the infective diseases should be rigorously observed as the disease is highly infectious.

ANTHRAX.

Synonyms.—Darka or Paschima (Bengal); Khurdwa (United Provinces); Sut or Garri (Punjab); Odro (Bombay) and Thomma (Madras).

It is a rapidly fatal disease due to the specific organisms, known as the *anthrax bacilli*, entering the system through any open sore in the skin, or with food, water or even air. The seeds or the *spores*, as they are called, of the organism retain their virulence for a great length of time and frequently conveyed by water. The disease spreads through the secretion and excretion of the affected animals, through human agency, utensils, fodder, etc., and also by direct contact. It attacks all animals (horses and cattle) including man. The incubation period is usually from 12 to 48 hours.

Symptoms.—The disease is characterised by a sudden attack, a severe and stormy course and a fatal termination. The general symptoms are high fever; quick pulse (70 to 100 beats per minute); want of appetite; muscular twitchings; rapidly increasing, painful and œdematous swelling of the head, neck, throat and tongue and purple discoloration of the lining membrane of the eyes, mouth and nose. There is generally bloody discharges from the mouth, nose and rectum and colicky pains associated with distention of the bowels with gas; gangrene of the swelled area may occur.

Death usually occurs in 10 to 24 hours or earlier and the mortality is from 80 to 100 per cent. One attack does not confer any immunity.

Treatment.—Medicinal treatment is of no avail on account of the suddenness of the attack and rapid course of the disease, but internal antiseptics and stimulants may be tried. For cattle an ounce of turpentine in a pint of linseed oil, or an ounce of phenyle in two quarts of water may be given. The swelling may be cauterised with hot iron.

Prevention.—Susceptible and incontact animals must be

protected by injecting antiserum or vaccine—the former affords a temporary, and the latter a long lasting, protection. Very careful disinfection of the standings where the sick animals have been kept is required. All suspected or infected pastures, food and watering places should be avoided for about three months.

Carcasses of animals dead of anthrax should be very carefully disposed of as they are a very fruitful source of infection. If not burnt they should be buried 6 feet below the surface of the earth in a bed of lime. They must be buried in tact and on no account the carcass should be cut or any part removed, as the blood is highly infective being charged with the germs. When removing the carcass all natural openings should be plugged with clay or cotton wool. The carcasses should not be buried near water courses and the graves should be dug in waste land.

HÆMORRHAGIC SEPTICÆMIA.

Synonyms :—Galaphula in Bengal, Ghararwa in U. P., Galghotu in the Punjab, Avrœ in Bombay and Ruttamuttiram in Madras.

Hæmorrhagic Septicæmia or malignant sore-throat is a highly fatal infective disease due to blood poison. Young animals are more frequently attacked and its chief victims are the buffaloes and bullocks. It occurs principally during the rains but specially after the Christmas rains, and is more prevalent in lowlying land subject to periodical inundations.

The incubation period is long and may extend even up to three months.

The *symptoms* are the appearance of a swelling usually at the throat which rapidly increases and the animal breathes and swallows with great difficulty. The swelling is hard, hot and painful, and does not crackle on pressure. There is high fever, flow of saliva from the mouth, purple discoloration of the

nose and eyes, swelling of the tongue, and during breathing a rattling noise is made which can be heard many yards off. The urine is sometimes bloody in appearance and the dung mixed with blood.

The duration of the disease is from 2 to 3 hours to as many days ; animals that live longer than three days usually recover.

An outbreak is usually over in 10 days and the mortality is from 80 to 100 per cent.

Treatment should always be prompt. Local swelling may be treated by making lines on it with a red hot iron but it should not go too deep. Antiseptic medicines such as an ounce of phenyle in two quarts of water, or better still two drams of carbolic acid or an ounce of cyllin in a quart of water for a dose may be given internally. But in all such cases a veterinary surgeon should at once be summoned as it may become necessary to open the windpipe should suffocation threaten.

Prevention.—When a single case occurs in the Gowkhana all the animals should be vaccinated with the weakened virus of the disease which gives protection for about a couple of years ; at the same time the preventive measures recommended to be adopted when other communicable diseases break out should at once be rigidly carried out. All suspected pastures should be avoided.

BLACK QUARTER.

This is also known as Quarterill or Blackleg, and as Jhang or Badlam in Bengal, Gathia in the United Provinces, Goli in the Punjab, Odoro in Bombay and Chuparinove in Madras.

It is an infective disease characterised by gas-containing swellings which may appear on the neck, back, quarter, loins or thigh. Its chief victims are the young and healthy buffaloes and cattle between the ages of 3 months and 4 or 5 years. It is usually contracted on certain grazing grounds

and appears in the same places and at the same seasons with great regularity. It occurs chiefly on swampy ground and one attack confers permanent immunity.

The cause is a microbe which gains admission into the system probably through some minute wound in the skin, generally of the leg and quarter, or the mucous membrane of the mouth and other parts of the digestive system.

The average period of incubation is about 48 hours. The disease has a very rapid course and generally ends fatally in 1 to 3 days. The mortality is from 90 to 100 p.c.

The *symptoms* may be divided into local and general.

The symptoms are lameness followed by the appearance of a gas-containing swelling or swellings on the upper parts of the thighs and quarter which rapidly spreads to the neck, shoulders and lower region of the chest. Sometimes there is one swelling and in other times several which may join together. The swelling is at first small and painful but rapidly increases and in about 8 hours or so may attain an enormous size. If it is now pressed it crackles as if blown out with air. It is now quite dark coloured, cold and painless due to the death of the part, and if cut much gas escapes and a sour-smelling, dark-coloured fluid comes out.

The general symptoms are dullness, isolation, i.e., keeping aloof from its companions, trembling, high temperature and increased and difficult respiration. The animal groans and gets colicky pains.

The treatment is entirely preventive which consists in vaccinating the susceptible animals with Dr. Holmes' pilules called 'black legoids.' For their injection the tip of the tail of the animal is preferred, as sometimes after injection certain violent symptoms are produced and the animal can then be saved by amputating the tail. The injection is given with a special syringe. Disinfect infected stables, avoid suspected pastures and watering places and burn or bury the dead.

PART IV
APPENDICES

APPENDIX A.

SECTIONS OF THE BENGAL MUNICIPAL ACT (BENGAL ACT III OF 1884) DEALING WITH SEWAGE, OFFENSIVE MATTER, RUBBISH, PRIVIES AND DRAINS.

186. The Commissioners shall provide all establishments, cattle, carts and implements required for the removal of sewage (a), offensive matter (b) and rubbish (c).
Establishments for removal of sewage, offensive matter and rubbish.

Note. In every municipality one of the duties of the Commissioners is to keep their own property, whether roads, drains or public conveniences, clean.

187. The Commissioners at a meeting may from time to time, by an order as prescribed in Sec. 354, appoint the hours within which it shall be lawful to remove sewage and offensive matter in the manner in which the same shall be removed, and may provide places convenient for the deposit thereof, and may require the occupiers of houses to cause the same to be deposited daily, or at other stated intervals, in such places, and may remove the same at the expense of the occupier from any house if the occupier thereof fails to do so in accordance with this Act.
Hours and mode of removal of offensive matter.

(Section 187 deals with the sewage and offensive matter and sec. 189 with the rubbish. Government has insisted on the extreme importance of disposing of night-soil in a methodical and inoffensive manner).

188. See page II.

189. The Commissioners at a meeting may, from time to time, by an order published as prescribed in section 354, appoint the hours within which only every occupier of any house or land may place rubbish on the public road adjacent to his house or land in order that such rubbish may be removed by the Commissioners ; and the Commissioners may charge such fees as they may think fit in respect of the
Commissioners may appoint hours for placing rubbish in public road.

(a) *Sewage* means night-soil and other contents of privies, drains and cess-pools.—*Vide* Sec. 6, Cl. (17), B. M. Act.

(b) *Offensive matter* means dirt, dung, putrid or putrefying substances and filth of any kind not included in the term "sewage".—*Vide* Sec. 6, Cl. (10).

(c) *Rubbish* means broken brick, mortar, broken glass, kitchen or stable refuse of any kind whatsoever not included in the term "offensive matter".—*Vide* Sec. 6, Cl. (14).

removal of such rubbish, with the consent of the occupiers of any house or land, from such house or land, or in respect of the removal from such public road of any rubbish which has accumulated in the exercise of a trade or business.

(Penalty for infringement is provided in section 216).

Drains, privies and cess-pools under control of Commissioners.

190. All drains, privies and cesspools shall be subject to the inspection and control of the Commissioners.

(This section gives the municipality control to a certain extent over all private drains, privies and cess-pools or cesspits).

191. The Commissioners, or any officer authorised by them in that behalf, may inspect all privies, drains and cesspools at any time between sunrise and sunset, after six hours' notice in writing to the occupier of any premises in which such privies, drains or cess-pools are situated, and may, if necessary, cause the ground to be opened where they or he may think fit for the purpose of preventing or removing any nuisance arising from such privies, drains or cesspools ; and the expenses thereby incurred shall be paid by the owner or occupier of such premises.

Inspection of drains, privies and cesspools.

193. The Commissioners may provide and maintain in sufficient numbers and in proper situations, common privies and urinals for the separate use of each sex, and shall cause the same to be kept in proper order and to be properly cleansed.

Common privies.

194. The Commissioners may license such necessities for public accommodation as they from time to time may think proper.

Licensing of public necessities.

196. All sewage, rubbish and offensive matter collected by the Commissioners from roads, privies, sewers and cesspools and other places shall be the property of the Commissioners who shall have the power to sell or otherwise dispose of the same ; and the money arising from the sale thereof shall be carried to the credit of the municipal fund.

All rubbish collected to be the property of Municipal Commissioners.

(The sale of street rubbish and the leasing out of trenching grounds are good sources of income in several municipalities).

197. All existing public sewers, drains and other conservancy works shall be under the direction and control of the Commissioners, who shall have power to construct any further works of that nature which they may consider necessary.

Sewers, drains, etc., under control of the Commissioners.

217. Any person who, in any municipality—(1) being the occupier of a house in or near a public road, keeps, or allows to be kept, for more than twenty-four hours, or for more than such shorter time as may be prescribed by a bye-law, otherwise than in some proper receptacle, any dirt, dung, bones, ashes, night-soil or filth, or any noxious or offensive matter, in or upon such house, or in any out-house, yard or ground attached to and occupied with such house, or suffers such receptacle to be in a filthy or noxious state, or neglects to employ proper means to cleanse the same, or

Occupier not removing filth, etc.

(2) keeps any public necessary without a license from the Commissioners under section 194, or having a license for a public necessary, suffers such necessary to be in a filthy or noxious state or neglects to employ proper means for cleansing the same, or

Keeping unlicensed public necessary.

(3) being the owner or occupier of any private drain, privy or cesspool, neglects or refuses, after warning from the Commissioners, to keep the same in a proper state, or

Not keeping private drain, etc., in proper order.

(4) disobeys an order passed by the Commissioners under the provisions of section 199 or 199 A, or

Disobeying order under section 199 or 199 A.

(5) encroaches upon any road, drain, sewer, aqueduct or water course by making any excavation, or by erecting any wall, post or other obstruction,

Erecting obstruction.

shall, for every such offence, be liable to a penalty not exceeding fifty rupees.

224. The Commissioners may require the owners or occupiers, or the owners and occupiers, of any land within fifteen days, to repair and make efficient any drain, privy or cesspool, or to remove any privy or close any cesspool which is situated on such land.

Commissioners may require owner or occupier to repair drain, etc.

(Disobedience is punishable under section 271.)

225. Every person constructing a privy shall have such privy shut out by a sufficient roof and wall or fence from the view of persons passing by, or residing in, the neighbourhood; and the Commissioners may require any owner or occupier of land on which a privy stands to cause the same to be shut out from view as aforesaid within fifteen days.

Privies must be properly enclosed.

(Disobedience is punishable under sections 266 and 271).

230. No person shall without the written permission of the Commissioners, construct or keep any latrine, urinal, cess-pool, house-drain or any other receptable for sewage or other offensive matter within fifty feet of a public tank or water course, or a tank or water course which the inhabitants of any locality use.

No latrine, etc., to be constructed within fifty feet of tank or water course.

The Commissioners may require any owner and occupier upon whose land any latrine, urinal, cesspool, house-drain or any other receptable so situated exists, or may hereafter be constructed, to remove the same within eight days.

[Contravention of these provisions is punishable under sections 270 (3) and 271].

231. No person shall, without the written permission of the Commissioners, construct a privy with a door or trap-door opening on to any road or drain. The Commissioners may require the owner or occupier upon whose land any such privy exists to remove the same within eight days.

Construction of privy.

[Contravention of these provisions is punishable under sections 270 (3) and 271].

266. Any person constructing a privy within a municipality, and failing to have it shut out from view, as in section 225 required, shall be liable to a fine not exceeding twenty rupees.

Failing to shut out privy from view.

270. Whoever, within a municipality,—

(1) without the permission of the Commissioners, throws or puts, or permits his servants to throw or put, any sewage or offensive matter on to any road, or who throws or puts, or permits servants to throw or put, any earth, rubbish, sewage or offensive matter into any sewer or drain belonging to the Commissioners, or into any drain communicating therewith, or

Throwing rubbish into sewers.

(2) causes or allows the water of any sink, sewer or cess-pool, or any other offensive matter belonging to him or being on his land, to run, drain or be thrown or put upon any road, or causes or allows any offensive matter to run, drain or be thrown into a surface drain near any road ; or

Allowing water of any sewer, etc., to run on any road.

(3) constructs a latrine, urinal, cesspool, house drain or privy in contravention of the provisions of sections 230 or 231 ; or

Constructing latrine, etc., in contravention of sections 230 and 231.

(4) without the written permission of the Commissioners, digs or makes, or causes or suffers to be dug or made, any excavation, cesspool, tank or pit, in contravention of the provisions of section 232, or

Making excavations.

(5) makes or repairs a roof or wall with grass, leaves, mats, or other inflammable material in contravention of the provisions of section 236 ;

Making a roof or wall of grass, etc.

shall be liable, for every such offence, to a fine not exceeding twenty-five rupees.

271. Whoever, within a municipality, fails to comply with a requisition issued by the Commissioners under the provisions of sections 224, 225, 227, 230, 231 or 238, shall be liable, for every such offence, to a fine not exceeding twenty-five rupees, and to a further fine, not exceeding five rupees, for every day during which he shall continue to make such default after service on him of such requisition.

Disobeying requisition under sections 224, 225, 227, 230, 231 or 238.

272. Whoever, within a municipality,—

(1) without the written consent of the Commissioners previously obtained, makes or causes to be made, or alters or causes to be altered, any drain leading into any of the sewers or drains vested in the Commissioners by this Act ; or

Altering, etc., drains leading to public sewers.

(2) constructs any branch drain, privy or cesspool contrary to the directions and regulations of the Commissioners or contrary to the provisions of this Act ; or, without the consent of the Commissioners, constructs, rebuilds or unstops any drain, privy or cesspool which has been ordered by them to be demolished or stopped up or not to be made ;

Making drains contrary to the orders of the Commissioners.

shall be liable, for every such offence, to a fine not exceeding fifty rupees.

320. In any municipality to which the provisions of this Part (*i.e.* Part IX) shall have been extended in the manner prescribed by section 222, the Commissioners may issue a notice declaring that, from a date to be specified in such a notice, they will maintain an establishment for the cleansing of private privies and cesspools within the limits of the municipality, or any part thereof ; and the Commissioners shall make suitable provision accordingly.

Notice to be issued by the Commissioners.

(*Note.*—After the Commissioners have undertaken this duty, the responsibility for cleansing rests on them. This part does not deal with public latrines ; they are provided for by sections 186 and 193 as part of the general conservancy).

321. When such provision has been made the Commissioners may levy fees, to be fixed on such a scale, with reference to the annual value of holdings containing dwelling houses or privies within the limits of the municipality or such parts thereof as aforesaid as the Commissioners at a meeting may from time to time direct * * *.

Commissioners may levy fees.

(The scale on which the fee is to be levied must be specially fixed by the Commissioners at a meeting ; if this is not done the tax will be *ultra vires*).

332. If the Commissioners think that any latrine or common latrine should be provided for any house or land within the limits of the municipality, the owners of such house or land shall, within fourteen days after notice given by the Commissioners, or within such longer time as the Commissioners may for special reasons allow, cause such latrine to be constructed in accordance with the requisition of such notice ; and if such latrine is not constructed to the satisfaction of the Commissioners within such period, the Commissioners may cause the same to be constructed, and the expenses thereby incurred shall be paid by the owners, and shall be recoverable as provided in section 322.

Commissioners may require latrine to be constructed, and in default may construct themselves.

350. The Commissioners of any municipality may, from time to time, at a meeting which shall have been convened expressly for the purpose and of which due notices shall have been given, frame such bye-laws as they deem fit, not being inconsistent with this Act, or with any other general or special law, for— * * *

Power to make bye-laws.

(c) regulating the disposal of sewage, offensive matter, carcasses of animals and rubbish, and the management of privies, cesspools and sewers ; * * *

and may by such bye-laws impose on offenders against the same such reasonable penalties as they think fit, not exceeding the sum of fifty rupees for each offence,

and in case of continuing offence a further penalty not exceeding twenty rupees for each day after written notice of the offence from the Commissioners.

APPENDIX B.

MODEL BYELAWS (SO FAR AS THEY ARE RELATED TO CONSERVANCY) FOR MUNICIPALITIES UNDER SEC. 350 OF THE BENGAL MUNICIPAL ACT (BENGAL ACT III OF 1884.)

(Published August 1912.)

NUISANCES ON OR NEAR ROADS.

37. No person shall convey sewage or offensive matter by any road otherwise than—

(a) in a closely-covered receptacle, of such description and pattern as are prescribed from time to time by the Commissioners at a meeting, and

(b) between such hours as are so prescribed.

Fine Rs. 10.

40. No person shall commit a nuisance by easing himself on or within sight of any road.

Fine Rs. 10.

45. No person shall throw, deposit or discharge any rubbish sewage or offensive matter into any river, stream, channel, tank or well which is used by the public.

Fine Rs. 10, on a second or subsequent conviction Rs. 50.

DISPOSAL OF SEWAGE AND OFFENSIVE MATTER.

56. No person shall deposit nightsoil in any place not approved by the Commissioners for the purpose.

Fine Rs. 10 ; on a second or subsequent conviction Rs. 50.

57. No owner or occupier of any garden or agricultural land shall, without the general or special permission of the Commissioners, cause or allow any human excrement to be used for manuring in such garden or land.

58. Any owner or occupier of any house, land or premises, from which sewage or offensive matter is not removed by such owner or occupier, shall give free access to the servants of the municipality for the

removal thereof within such hours as may have been fixed by the Commissioners.

Fine Rs. 10, on a second or subsequent conviction Rs. 50.

59. Every owner, occupier a farmer of any market shall remove or cause to be removed therefrom, once in every 24 hours, any offensive matter which may have been accumulated therein during that period.

Fine Rs. 10, on a second or subsequent conviction Rs. 50.

DISPOSAL OF CARCASSES.

60. Every owner or occupier within whose premises any animal dies shall, within 6 hours after its death, or if the death occurs at night, then within 6 hours after sunrise, either remove the carcass at his own expense, to such a place as may be set apart by the Commissioners for the disposal of such purposes, or report the death to the conservancy overseer of the ward within which such premises are situated.

Fine Rs. 10.

LATRINES.

61. No male person above 12 years of age, except the municipal inspecting officers for purposes of inspection at such times as the Commissioners may fix in this behalf, shall enter any public latrine intended for the use of females.

Fine Rs. 10.

DRAINS.

62. No person shall deposit or cause to be deposited, in or on the side of a public drain, any substance or thing which will cause obstruction to such drain.

Fine Rs. 10.

63. No person shall construct or place over, or by the side of, any public drain, any stall, bridge, platform, building or structure of any kind except with the general or special permission of the Commissioners and in such manner as they may direct.

Fine Rs. 10 ; daily fine Rs. 2.

64. No person shall ease himself at the side of any drain.

Fine Rs 10.

PREVENTION OF NUISANCE.

75. Every owner or occupier of any land shall, within 48 hours after service of a notice in this behalf from the Commissioners :—

- (a) clear the land of dirt, dung, bones, ashes, sweepings and nightsoil and other filth, and all other noxious or offensive matter, and
- (b) fence the land so as to prevent the commission thereon of nuisances affecting public health, safety or convenience.

Fine Rs. 10; daily fine Rs. 2.

80. When a urinal or latrine has been provided for any market, no person shall satisfy a call of nature at any place within the market, except at the urinal or latrine so provided.

Fine Rs. 10.

81. When places for the performance of offices of nature have been provided by the Commissioners, no person shall satisfy a call of nature at any other place outside private premises.

Fine Rs. 10.

APPENDIX C.

SECTIONS OF THE PURI LODGING HOUSE ACT (BENGAL ACT IV
OF 1871, AS MODIFIED UP TO 1ST JUNE 1908) RELATING TO
CONSERVANCY.

2. The Lieutenant Governor of Bengal is hereby empowered to appoint a Health Officer to control and direct the sanitation and conservancy of the town of Puri (\$) and of the main lines of road leading thereto.

24. Whoever deposits, or permits his servants to deposit any dust, dirt, dung, ashes or refuse, or filth of any kind, or any animal matter, or any broken glass or earth-ware or other rubbish, in any public highway, except in such convenient spots, and in such manner, and at such hours as shall be fixed by the Magistrate with the assent of the Health

Appointment of Health Officer.

Depositing dirt, etc., in highways and sewers.

(§) In places to which this Act has been extended under the Puri Lodging House (Extension) Act, 1879 (Ben. Act II of 1879), s. 3, the name of the place concerned is substituted for “Puri” in sections 2 and 3.—See Ben. Act II of 1879, section 3.

Officer or throws or puts, or permits his servants to throw or put, any such substance into any public sewer or drain, or into any drain communicating therewith, shall be liable to a fine not exceeding ten rupees.

25. Whoever causes, or allows the water of any sink or sewer, or any other offensive liquid matter belonging to him or being on his land, to run, drain or be thrown or put upon any public highway, or causes or allows any offensive matter from any sewer or privy to run, drain or be thrown into a surface drain in any such high-way, shall be liable to a fine not exceeding ten rupees.

Putting offensive matter
to run into drains or upon
public highways.

30. Whoever being the owner or occupier of any private drain privy or cesspool, shall neglect or refuse, after warning from the Health Officer, to keep the same in a proper state shall be liable to a fine not exceeding fifty rupees.

Clearing drains and
cesspools.

APPENDIX D.

MUNICIPAL SANITATION.

MODEL BYELAWS UNDER THE LODGING HOUSE

ACT IV (B.C.)

(Sections relating to Conservancy)

2. All public or private privies, latrines, urinals, drains and cesspools, and all receptacles and utensils used in connection therewith, shall be subject to the inspection and control of the Magistrate, the Civil Surgeon of the District, and the Health Officer.

3. The Magistrate, may require the owners or occupiers, or the owners or occupiers of any house or land, within fifteen days to repair or make efficient any privy, latrine, urinal, drain, or cesspool, or any receptacle or utensil used in connection therewith, or to remove any privy, latrine, or urinal, or to close any cesspool which is situated on such house or land. Whoever being an owner or occupier of any house or land fails to comply with any requisition issued under this byelaw, shall be liable for every such default, to a penalty not exceeding Rs. 20, and to a further penalty not exceeding Rs. 5, for every day

during which the default is continued after the expiration of fifteen days from the date of service on him of such requisition.

4. Any person carrying nightsoil, or other offensive matter through the town otherwise than in a closely covered receptacle shall be liable to a fine not exceeding Rs. 5.

5. Any sweeper neglecting to remove nightsoil from any part of the quarter for which he is responsible once in 24 hours, shall be liable for each omission to a fine not exceeding Re. 1.

9. * * * Sufficient latrine accommodation shall also be provided, not being ordinarily less than two privies for men and three for women for every hundred pilgrims. * * *

APPENDIX E.

MODERN RULES AS TO PRIVATE PRIVIES AND URINALS.

(GOVERNMENT OF BENGAL.)

[*Vide—Act III of 1884, Section 350 (C)*]

1. (1) No privy shall be placed in the space required by this Act to be left at the back of a building—

(a) unless the total height of the privy does not exceed 11 feet,
and

(b) unless there is a space of at least 4 feet between the nearest wall and the service aperture of the privy.

(2) No privy situated in, or adjacent to, a building shall be at a distance of less than—

(a) six feet from any other building which is a public building,
or

(b) four feet from any other building which is, or is likely to be, used as a dwelling place, or as a place in which any person is, or is intended to be, employed in any manufacture, trade or business.

2. (1) No privy shall be placed on any upper floor of a building...

3. (1) If there is no convenient access from a street to any privy, the Commissioners may, if they think fit by a written notice, require the owner of the privy to form a passage giving access to the privy from the street.

(2) Every notice served under sub-rule (1) must require that such passage be formed at ground-level, but not less than four feet wide, and be provided with a suitable door, and must inform the said owner that the passage may, at his option, be either opened to the sky or covered in.

4. Models and type-plans of privies and urinals, approved by the Commissioners, with estimates of the cost of constructing privies and urinals in accordance therewith, shall be kept in the Municipal office and shall be open to inspection by any person at all reasonable times without charge ; but no person shall be bound to construct any privy or urinal in accordance with any such model or type-plan if the same be constructed in accordance with other rules contained in this Schedule.

5. (1) A drain must be provided for every privy and every urinal.

(2) Such drain must be constructed of some impervious material, and must connect the floor of the privy or urinal—

(a) with the drain communicating with a municipal drain or sewer, or

(b) if permitted by the Commissioners, with any impervious cesspool, the contents of which can be removed either by hand, or by flow after filtration.

6. (1) The floor of every privy and urinal—

(a) must, if the Commissioners in any case so direct, be made of one of the following materials to be selected by the owner of the privy or urinal, that is to say, glazed tiles, artificial stone or cement, or

(b) if no such direction is given, must be made of thoroughly well-burnt earthen tiles or bricks plastered, and not merely pointed, with cement, and

(c) must be in every part at a height of not less than six inches above the level of the surface of the ground adjoining the privy or urinal.

(2) The floor of every privy and every urinal must have a fall or inclination of at least half an inch to the foot towards the drain prescribed by rule 5 ; and the platform must be similarly sloped towards the aperture.

7. The walls and the roof (if any) of every privy and urinal shall be made of such materials as may be approved by the Commissioners :

Provided that—

- (a) in the case of privies, the entire surface of the walls below the platform shall either be rendered in cement or be made as prescribed in clause (a) or clause (b) of rule 6.

8. The platform of every privy or urinal must either be plastered with cement or be made of some water-tight non-absorbent material as prescribed in rule 6.

9. Every privy or urinal situated in, or adjacent to, a building must have an opening, of not less than three square feet in area, in one of the walls of the privy, as near the top of the wall as may be practicable, and communicating directly with the open air.

10. Every privy must be constructed in accordance with the following provisions—

- (a) the space beneath the platform of the privy must be of such dimensions as to admit of one or two movable receptacles for sewage of a capacity not exceeding one cubic foot, being placed and fitted beneath the platform in such manner and position as will effectually prevent the deposit, otherwise than in such receptacle of any sewage falling or thrown through the aperture of the platform ;
- (b) the privy must be so constructed as to afford adequate access to the said space for the purpose of cleansing such place and of placing therein and removing therefrom proper receptacle for sewage ;
- (c) the said receptacles must be water-tight, and must be made of metal if their capacity is over half a cubic foot, or of well-tarred earthenware or glazed stoneware if their capacity is less than half a cubic foot ;
- (d) the door for the insertion and removal of receptacles must be made so as to completely cover the aperture.

11. (1) If any privy or urinal erected or re-erected after the passing of these rules is so constructed as to contravene any of the provisions of this Schedule, the Commissioners may, by written notice, whether or not the offender be prosecuted under the Municipal Act before a Magistrate, require—

- (a) the occupier of the building to which the privy or urinal belongs, or
- (b) (if the privy or urinal does not belong to a building) the owner of the land on which the privy or urinal stands, to make such alterations as may be specified in the notice with the object of bringing the privy or urinal into conformity with the said provisions.

APPENDIX F.

BENGAL LOCAL SELF-GOVERNMENT ACT.

(B. C. Act III of 1885 as amended by B. C. Act V of 1908).

Sec. 115. Every Union Committee shall, subject to the control of the District Board, and in accordance with rules made by the Lieutenant Governor under this Act,—

Duties of Union Committee as to sanitation, conservancy and drainage.

- (1) provide, as far as possible, for the sanitation and conservancy of the Union and the prevention of public nuisances therein ;
- (2) make special arrangements for the sanitation and conservancy of fairs and *mélas* held within the Union ;
- (3) have control of all drains and other conservancy works within the Union which are not under the control of any other authority ; and
- (4) execute all works which are necessary for improving the sanitation, conservancy or drainage of the Union :

Provided that the District Board may itself undertake any such work which by reason of its magnitude, or of the amount of expense likely to be incurred thereon, cannot, in the opinion of the District Board, be satisfactorily executed by the Union Committee.

116. (1) If it appears to the Union Committee that, for any reason, it is necessary to improve the sanitary condition of any village or part of a village within the Union, the Committee may in accordance with the scheme approved by the District Board and sanctioned by the Commissioner under rules made by the Lieutenant-Governor under this Act,—

Powers of Union Committee as to sanitation, conservancy and drainage.

- (a) cause huts or privies to be removed, either wholly or in part ;
- (b) cause private drains to be constructed, altered or removed ;
- (c) cause streets, passages and public drains, to be constructed or widened ;
- (d) cause tanks or low lands to be filled up or deepened ; and

- (e) cause such other improvements to be made as, in its opinion, are necessary to improve the condition of such village or part.
- (2) The Union Committee may, by written notice,—
 - (i) require the owner or occupier of any hut, or the owner of any privy, to remove such hut or privy, either wholly or in part, in pursuance of clause (a) of sub-section (1); or
 - (ii) require the owner or occupier of any building to construct private drains therefor, or to alter or remove private drains thereof, in pursuance of clause (b) of sub-section (1), within a period to be specified in the notice.

(3) If any work required by any such notice is not executed within the period specified in the notice, the Union Committee may themselves cause such work to be carried out.

(4) All expenses incurred by the Union Committee under sub-section (1) or sub-section (3), including such reasonable compensation as the Committee may think fit to pay to the owners or occupiers of huts or privies removed, shall be met out of the Union Fund.

(This section gives Union Committee powers as to sanitation, conservancy and drainage).

117. (1) The Union Committee may, with the sanction of the District Board, employ a special establishment for the cleansing of any village within the Union.

Cleansing of villages.

(2) If any village for which no establishment is maintained under sub-section (1) appears to the Union Committee to be in a filthy condition, the Committee may, by written notice, require the persons who occupy buildings in the village to cleanse their holdings to the satisfaction of the Committee, within a period to be specified in the notice.

(3) If any person on whom notice has been served under sub-section (2) fails to comply with the requisition contained in the notice, the Union Committee shall, unless reasonable cause to the contrary is shown, cause his holding to be cleaned, and recover from such person such portion of the costs of such cleansing as may be approved by the Sanitation Committee, as if the same were an arrear of assessment imposed under the village Chaukidari Act, 1870, or, where the Chota Nagpur Rural Police Act, 1887, is in force, under that Act.

(This gives powers to Union Committees to the cleansing of villages. A special establishment may be employed for the purpose).

APPENDIX G.

HOOKWORM DISEASE OR ANKYLOSTOMIASIS.

Hookworm infection is due to the pollution of soil with human excreta, and as the prevention of soil pollution and improved conservancy arrangements are the principal factors for stopping the spread of this disease which is responsible for so much physical degeneration and economic loss a small chapter dealing with its causation and prevention in a book on conservancy will, it is hoped, not be grudged by any one interested in sanitation.

The disease has existed for centuries and perhaps with the possible exception of malaria is one of the commonest of all tropical diseases.

The disease is **caused** by the presence in large numbers of a certain kind of worm, known as hookworm or *Ankylostoma Deodenale*, in the human alimentary canal. The worms are, roughly, $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, a little larger than ordinary sewing cotton in diameter, and are yellowish white in colour when empty but reddish brown when filled with blood. The disease is marked by anæmia due, it is believed, to the production of a poison or toxin by the worms which also suck the blood of the host.

The disease is believed to have been known to ancient Egyptians under the term *heltu*, which is mentioned in the *Ebers Papyrus* written about 1550 B.C. Another ancient reference occurs in the Sanskrit *Harita Samhita*, where it is recorded that the trouble was due to swallowing clay. But whatever the ancient knew about the ankylostoma soon disappeared from the stock of human knowledge, and it was only in 1883 that Dubini discovered the worm which is responsible for such widespread distress. It was however not till the boring of the St. Gothard Tunnel in the early eighties that the disease attracted general attention among the medical men of Europe. The Italian excavators suffered so much from this parasite that increasing interest was taken in it, and now it was recognised as causing a dangerous and not infrequently a fatal disease.

The disease is very widely distributed. In Egypt it is found in nearly all natives. In parts of India 75 to 80 per cent. are infected, and it seems to be equally common in Ceylon, the Straits Settlements, Java, China, Japan, the Philippines, the warmer parts of South America and the West Indies, and in the warmer parts of Europe and North America. In 1902 ankylostoma was discovered in the tin mines of Cornwall and it has

caused infinite harm in the coal mines of central Europe. Once established in the larval state in the heat and moisture of a mine, it is very difficult to eradicate. When some years ago this disease appeared in certain mines in Cornwall a local poet and a strong Churchman noted its presence in the following verse :—

If modern saints worked miracles,
The Bishop of this diocese
Would quickly rid the Cornish mines
Of Ankylostomiasis.

As is usual with parasitic worms, the male is comparatively small in number and size compared with the female. The worm cannot shut its mouth, it is perpetually open. Inside it is provided with certain strongly recurved hooks. Into this mouth and indeed quite a long way into the gullet is dragged a portion of the soft mucous membrane of the alimentary canal of the host, and it is on the cells covering this that the worm lives. It is believed that from time to time the worm shifts its position and that the abandoned bite bleeds.

Fig. 39. Male and female hookworm, natural size.

A female ankylostoma produces a never-ending stream of eggs,—oval, transparent, delicate looking structures which pass out in the excreta, and favoured by heat and moisture develop in the soil in about three days into minute larvæ ; these larvæ are very hungry and vigorous, devouring whatever organic matter they can find so that within a week a larvæ



Figs. 40, 41 and 42. Diagrams showing mode of infection. The larva often crawls up a blade of grass and waits till somebody comes along barefoot and gives him ground itch.

trebles its size, but even then it is very minute. These larvæ have a most extraordinary power of attaching themselves to, and penetrating into, the human skin and body. It is probable that in 90 per cent. of cases infection is contracted in this way. They may also enter the human body in a drink of water or on unwashed vegetables. In badly infected regions the soil in the vicinity of the dwellings becomes fairly alive with these larvæ, and it is hardly possible for a person to walk bare-foot outdoors without becoming infected. In these circumstances attacks of what is known as *ground itch* characterised by intense itching and slight eruption may



Fig 43. "Ground-itch" or "water-sores" as it occurs among coolies in tea gardens.

occur among those exposed to infection. When the larvæ have penetrated the hand or foot they begin a long and circuitous journey through the body and being swept along by the blood stream they easily reach the lungs. Once arrived in the lungs the larvæ have no difficulty in traversing the soft pulmonary tissue and making their way in the cavity of the respiratory organs. Thence they travel along the bronchial tubes and so to the windpipe and into the larynx and up almost into the mouth, and here they turn back into the

gullet or food-pipe and so down into the stomach and intestine. The whole of this remarkable journey takes about a week or two. In the intestines the larvæ develop into adults and in about eight days they become capable of reproduction and in a few more days the eggs are then passing away from the body of the host. The whole cycle of their life history occupies, under favourable circumstances, about 8 weeks. It should be borne in mind that the eggs of the worm will not hatch within the human host but require to be deposited on moist, warm earth, or other suitable medium.

The **symptoms** which these worms give rise to are dyspepsia, indigestion and bloodlessness. On account of the apathy, lack of energy and anæmia which frequently results from its presence, the condition has also been called *lazy disease*. The worms suck people's blood and at the same time poison them. Men, women and children attacked by these worms grow weak and stupid and disinclined or unable to work. There may be palpitation, shortness of breath and also muscular weakness.

Headache is common and the expression is usually dull and stupid and there may be puffiness of the face and œdema of the ankles. Memory becomes defective and there is a general lack of ambition and initiative. Hookworm in children results in relaxed mental and physical development and puberty is delayed.

That the infection is so common is explained by the fact that soil pollution is universal in this country. Even in big towns where privy exists the danger of infection is not thereby excluded. It has been shown that the soil around privies that are no longer in use may remain infected for about 5 months, although infection decreases considerably after four months. Desiccation of infected soil kills all hookworm larvæ that may be present. In undiluted fœces all ova hatch out within four days but unless they can escape within ten days they die. When fœces are passed on the surface of the ground the larvæ that hatch out can readily find their way into the soil which is rarely sufficiently dry to cause their death. The ova develop very rapidly in moist soil, and also when fœces are passed in water, provided the dilution is not too great. Diluting night-soil with water—one part in 1,000 or 2,000 of water—causes the larvæ to perish and prevents the ova developing.

When fœcal matter has undergone decomposition under water most of the hookworm eggs are dead in ten weeks and probably all of them after three months. It is not safe to use this as a fertilizer for land in less than three months. Larvæ may live in water at least 30 days. They do not readily swim about in water but remain at the bottom of a collection of contaminated water. Sea water is supposed to destroy hookworm ova in 37 minutes. Disinfectants are mostly useless.

The **prevention** and eradication of hookworm disease consist principally in taking measures to stop the pollution of the soil. This is a very difficult problem as the people of this country have been accustomed

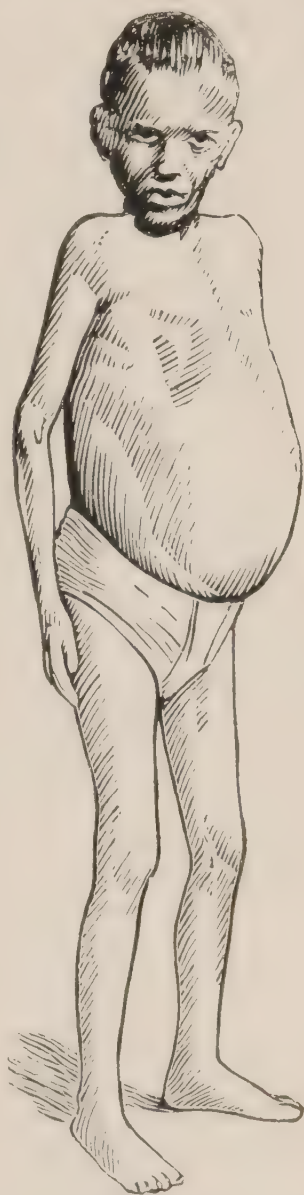


Fig. 44. Shows the appalling effect of hookworm disease complicated with malaria. This Indian boy of 17 weighed only 42 pounds.

from time immemorial to pollute the soil with their excreta, often in the vicinity of their houses. But they should at first be convinced of the danger of soil pollution and explained the construction and use of privies or trench latrines, etc., and advised also to wear shoes or wooden sandals (*khurrams*) which are a great safeguard. It has been found that Europeans and wealthier Indians who habitually wear boots or shoes rarely contract this disease. The sufferers should also be treated by competent doctors in order to be freed of the parasite.

As the disease is robbing the people of their health, their wealth, and their lives it is the duty of every sanitary officer to do his best to fight out the malady by introducing the proper type of latrine or privy—*aqua* or pit (well) privy,—and preventing people from polluting the ground surface with nightsoil. Anyone who pollutes the soil is a danger to the whole community. “Hookworm disease bequeathes in a pernicious legacy to the infected communities, its work being done in a subtle insidious manner, weakening the race generation after generation, always tending to produce a condition of physical, intellectual, economic and moral degeneracy.”—Bentley.

INDEX

A

	PAGE
Abscesses, ...	140
„ treatment of	140
Aging animals ...	121
Aishoo ...	153
Allotment of privies	65
Anthrax, ...	156
„ prevention of	156
„ symptoms of	156
„ treatment of	156
Animals, number required	23
Ankylostomiasis...	178
Ankylostoma Deodenale	178
Antisplash pails	52
Aqua privy ...	97
Avrœ ...	157

B

Bacteria ...	144
Bacteriological filter	108
Badlam ...	158
<i>Bajra</i> ...	130
Barley ...	128
Basanta ...	150
Baskets ...	21
<i>Bhangis</i> ..	45
<i>Bhusa</i> ...	129
Biological disposal of nightsoil ...	92
Black legoids ...	159
Black quarter, ...	158
„ „ symptoms of	159
„ „ treatment of	159
<i>Bran</i> ...	129
„ <i>mash</i> ...	129, 133

B—contd.

	PAGE
Broken horns, ...	136
„ „ treatment of	136
Broomsticks ...	21
Brushes ...	21
<i>Bustee</i> ...	6
C	
Carbolic Acid ...	147
Carcass, byelaws for disposal	170
„ cart ...	39
„ disposal of	40
„ removal of	39
Carts, number required	23
Carters, duties of	9
Cattle feeding of	131
„ management, prelimi- nary remarks	116
„ plague ...	150
„ shed ...	118
„ shoeing ...	123
„ yard ...	117
Cesspit, ...	52
„ control of	163
„ construction of	52
Chaprassi, duties of	8
Chichuk ...	150
Chuparinove ...	158
Colic, ...	140
„ symptoms of	141
„ treatment of	141
Collection of refuse	14
„ „ nightsoil	65
Commode ...	54
Common privy ...	164

C—*contd.*

	PAGE
Concentrated food ...	127
Conservancy in fairs ...	111
" map ...	6
" officer, duties of ...	7
" " qualification of... ..	7
" staff, division of ...	6
" system, introductory	
remarks ...	43
" tax ...	44
" unit ...	5
Contract system, for conser-	
vancy work ...	4
" " drawbacks of ...	4
Cost for refuse removal ...	25
<i>Cyllin</i> ...	148

D

Darka ...	156
Dentition of animals ...	122
Detritus chamber ...	95
<i>Dhoob</i> grass ...	126
Diarrhœa, ...	142
" treatment of ...	143
Disinfectants ...	147
Disposal of carcass ...	39, 40
Displacement of patella, ...	137
" " " treat-	
ment of ...	137
Disposal of nightsoil, ...	79
" " " biological	
method ...	92
" " refuse ...	27
" " sewage into sea... ..	91
Distribution of latrines ...	57
<i>Domes</i> ...	6
Dry method of sewage re-	
moval ...	43

D—*contd.*

	PAGE
Drains, alterations in ...	167
" byelaw for inspection ...	170
" inspection of ...	164
" <i>kutchā</i> ...	104, 105, 106
" <i>kutchā-pucca</i> ...	107
" <i>pucca</i> ...	107
" repairs of ...	165
Dry grass, ...	126
Dum Dum Sore, ...	137
" " " treatment of... ..	137
Dumping, ...	27
" advantages of ...	31
" drawbacks of ...	30
" Septic tank ...	92
Dust ...	4
Dustbin, ...	15
" distribution of ...	15

E

Excreta, removal of ...	120
-------------------------	-----

F

Fairs, conservancy in ...	111
Feeding of animals ...	125
" " cattle ...	131
" principles of ...	125
" troughs ...	119
Fixed latrines ...	57
Foot-and-mouth disease, ...	153
" " " diag-	
nosis of ...	154
" " " symp-	
toms of ...	154
" " " treat-	
ment of ...	155
<i>Formalin</i> ...	148

G			H—contd.		
		PAGE			PAGE
Galaphula	...	157	Hand removal system,	...	43
Galhotu	...	157	" " " draw-		
Garri	...	156	" " " backs of	...	90
Gathia	...	158	" " " merits of	...	90
Genawa grass	...	126	Harnessing	...	123
Ghararwa	...	157	Hay	...	126
Ghutia	...	19	Hay tea	...	133
Goala busti cart	...	77	Healthy animals	...	120
" refuse	...	18	Holmes' pilules	...	159
" staff	...	6	Hookworm Disease,	...	178
Goli	...	158	" " " causes of	...	178
Good bull	...	121	" " " symptoms of	...	180
Gooti	...	150	" " " prevention		
Gowkhana	...	117	" " " of	...	181
" Superintendent	...	117	Horse dropping pans	...	21
Grains	...	127	House drain, sites for	...	166
Gram	...	128	" " removal of	...	166
Grasses, artificial	...	126	" " unauthorised		
" natural	...	125	" " construction of	...	166
" fresh	...	126	Household refuse	...	4, 14
" green	...	126	Hoven,	...	141
" kinds of	...	126	" treatment of	...	142
Grit chamber	...	95			
Ground itch	...	180			
Gruel, linseed	...	132			
" rice	...	129			
" suttoo	...	133			
Guinea grass	...	126			
H			I		
Hæmorrhagic septicæmia,	...	157	Incineration,	...	32
" " pre-			" in Calcutta	...	36
" " vention of	158		" of nightsoil	...	89
" " symp-			" " refuse	...	32
" " toms of	157		Incinerator,	...	34
" " treatment			" site for	...	33
" " of	158		" sma'l	...	35
			Incubation period	...	148
			Indian corn	...	128
			Infective diseases,	...	144
			" " prevention of	...	144
			" " repression of	...	145

J		M	
	PAGE		PAGE
Jhang	158	Made soil	27
Jowar	130	Maize	128
K		Makkai	128
Kachra	88	Malignant sore-throat	157
Khoorpakha	153	Manuan	150
Khoorwa	153	Manure channel	119
Kodalís	21	Matah	150
Khurdwa	156	Melas, conservancy of	111
Khurrams	182	Methers,	45
Khus Khus grass	126	" duties of	67
Kutcha drains	104	" number required	65
Kutcha pucca drains	107	Mistrikhana	5
Kulthi	130	Moist heat	148
L		Mukhur	153
Labour staff	24	Moopaung	153
Latrine,	44, 46	Moong	130
" byelaw for inspecting	170	Movable latrine	60
" distribution of	57	Municipal Workshop	5
" fixed	57	Muster	8
" kinds of	57	N	
" movable	60	Nasik system	88
" permanent	57	Neck galls	135
" principles of construc-		" " treatment of	135
tion of	47	Night soil, cart	76
" removal of	166	" collection of	65
" sites for	166	" disposal of	79
" temporary	60	" incineration of	89
" unauthorised cons-		" quantity requiring	
truction of	166	removal	68
" waste	2	" removal,	68, 70
Lazy disease	180	" " by railway	72
Linseed	130	" " receptacle	
" gruel	132	system	72
" meal	130	" transfer depot	71
" tea	130, 132	" trenching	80
Lodging House Act, Puri	171	Night service	66
" " Byelaws	172		

N—*contd.*P—*contd.*

	PAGE
Nuisances, byelaws ...	169
" " for prven- tion of ...	171
O	
Oats ...	127
Odor ...	156, 158
Offensive matter, byelaw for disposal ...	169
Offensive matter, definition ...	163
" " establishment for removal ...	163
" " hours for re- moval ...	163
" " mode of re- moval ...	163
" " non-removal of ...	165
" " penalty for non-removal ...	165
Oil cakes ...	130
P	
Paddy ...	129
Pails ...	75
Pail depot ...	71
Paschima ...	156
Patella, displacement of ...	137
" " treatment ...	137
<i>Pater Ausook</i> ...	142
Perchloride of mercury ...	147
Permanent latrines ...	57
Peya ...	150
<i>Phenyle</i> ...	148
Pitchinow ...	150
Pitting system ...	87
Powers of entry in houses ...	163
Principles of feeding cattle ...	125

	PAGE
Private drains, control of ...	163
Privy, ...	44, 46
" accommodation ...	54
" allotment of ...	65
" alterations in ...	167
" cleansing of ...	65
" common ...	163
" construction of ...	48, 166
" construction by muni- cipality ...	168
" control of ...	164
" enclosure of ...	165
" Government rules for ...	173
" inspection of ...	164
" levying fees for ...	168
" pan ...	51
" parts of ...	48
" platform ...	49
" principles of construction ...	47
" removal of ...	165
" repairs of ...	165
" site for ...	47
" superstructure of ...	50
" unauthorised construc- tion of ...	166
" washing ...	69
<i>Protozoa</i> ...	144
Public latrine, ...	56
" " distribution of ...	57
" " kinds of ...	57
" " necessaries, licensing of ...	164
Q	
Quantity of refuse, estimation of ...	21

R

R—contd.

	PAGE		PAGE
Receptacle system of night		Rubbish, hours for removing	162
soil removal ...	72	mode of removing...	162
cart ...	73	property of munici-	
Reclamation ...	27	pality ...	164
Refuse ...	3	Roots ...	131
cart ...	17	Ruttamurthiram ...	157
particulars of ...	19		
estimation of num-		S	
ber required ...	23	<i>Scalded oats</i> ...	133
for <i>goala bustee</i> ...	18	Scavenging system, ...	4
Refuse, collection of ...	14	estimation	
disposal, ...	27	of animals required for ...	23
methods of ...	27	<i>Septic tank</i> ...	93
in rural areas ...	37	Sewage, definition of ...	162
estimation of quantity	21	disposal, bye law for	169
household ...	14	at sea ...	169
incineration of ...	32	establishment for re-	
removal, ...	5, 13	moval of ...	163
cost for ...	25	mode of removal ...	163
by railways ...	5	Shoeing cattle ...	123
motors ...	5, 17	horses ...	124
sources of ...	14	preparation of foot	
street ...	14	for ...	123
trade ...	4, 14	Sick diets ...	132
Removal of excreta ...	120	Sludge ...	95
of night soil ...	68, 70	Small incinerators, ...	35
Rice ...	129	advantages of ...	35
<i>kunji</i> ...	129, 132	description of ...	34
Rinderpest, ...	150	Sources of refuse... ...	14
prevention of ...	153	<i>Spear grass</i> ...	126
symptoms of ...	151	Sprains, ...	138
treatment of ...	152	treatment of ...	138
Road sweepers ...	16	Stalls, cleansing of ...	146
<i>Rokgalla</i> ...	142	disinfection of ...	146
Rubbish, definition of ...	162	<i>Standard food</i> for horses ...	126
establishment for re-		Straw ...	127
moving ...	163	Street refuse ...	14

S—*contd.*

	PAGE
Street rubbish ...	4
„ sweeping ...	16
Strike of sweepers ...	12
<i>Sullage</i> , ...	4
„ disposal of ...	104, 108
„ filter ...	108
Sunstroke, ...	143
„ symptoms of ...	143
„ treatment of ...	143
Sut ...	156

T

Tank filling with sweepings ...	28
„ „ advantages of ...	31
„ „ drawbacks of ...	30
„ „ precautions neces- sary ...	28
Temporary latrine ...	60
Thomma ...	156
Thornhill system ...	87
Time keeper ...	9
<i>Toxin</i> ...	144
<i>Trade refuse</i> ...	4, 14
Trenching, nightsoil ...	80
„ experiments on ...	83
„ hints on ...	84, 85, 86
„ other methods of ...	87
<i>Trenching ground</i> , ...	80
„ „ manage- ment of, ...	81
<i>Trench latrines</i> ...	55

T—*contd.*

	PAGE
Tympanitis ...	141
„ treatment of ...	142
U	
<i>Urid</i> ...	130
Urinals, ...	61
„ Government rules for ...	173
„ removal of ...	166
„ sites for ...	166
Union Committee, duties relat- ing to conservancy ...	176
Union Committee, powers relating to conservancy ...	176
Unit of conservancy ...	5
V	
Villages, cleansing of ...	177
„ refuse disposal in ...	37
W	
Watering of animals ...	134
Well privy ...	56
Wheat ...	129
<i>Wheel barrow</i> , ...	20
„ „ men, number required ...	25
Work for animals ...	134
Work shop ...	5
Wounds, ...	139
„ treatment of ...	139
Y	
Yoke galls, ...	135
„ „ treatment of ...	135



Third Edition

Revised and Enlarged

A TREATISE ON Hygiene and Public Health

WITH SPECIAL REFERENCE TO THE TROPICS

BY

BIRENDRA NATH GHOSH, F.R.F.P.S. (Glasg.)

Fellow of the Royal Society of Medicine, Fellow of the Royal Institute of Public Health, London; Examiner in Hygiene, University of Calcutta.

AND

JAHAR LAL DAS, L.M.S. (Cal. Univ.)

Member of the Royal Sanitary Institute, London, Teacher of Hygiene in the Training Class for Sanitary Inspectors, Bengal; Formerly Health Officer of Maniktala, Calcutta, &c.

WITH AN INTRODUCTION BY

**Col. KENNETH MACLEOD, M.A., M.D., L.L.D., F.R.C.S.,
I.M.S. (Rtd.)**

Honorary Physician to his Majesty the King.

*Crown 8vo. Full Cloth. pp. 397 + xvii. Price Rs. 4/8/- net
or six shillings.*

PRESS OPINIONS.

"This is an excellent little volume. It is specially written from the point of view of tropical conditions, and as such is strongly to be commended. We specially commend the practical and careful chapters on Indian dietetics, both for Europeans and natives of India, and we are glad to see a fair and clear discussion of the subjects of Indian diet and physical development. We can strongly recommend this volume as an admirable text-book for students and practitioners."—INDIAN MEDICAL GAZETTE.

"In this volume the authors have endeavoured to give a concise, thoroughly reliable and modern account of hygiene and public health, and in this aim they have been fairly successful. The first two chapters deal with water and air, and, in direct relation to the latter, ventilation and cooling are next considered. Several chapters are devoted to food and drink, including one on diet in India. Almost one hundred pages are given to the discussion of infection and infectious diseases. Sanitary arrangements in India leave much to be desired, and if this volume helps to stimulate the much-needed reforms in sanitation, it will have accomplished a great deal. The book is a very useful compilation in this branch of medicine, and should prove most serviceable to medical workers in tropical countries."—PRESCRIBER.

"It is clearly and concisely written, and although not intended to take the place of larger works on the subject, it will be found usefully to fulfil its purpose."—JOURNAL OF STATE MEDICINE.

"The authors are to be congratulated on joining the still far too small band of indigenous workers, who perceive that in India, as elsewhere, the wealth and contentment of populations are intimately connected with health conditions."—TROPICAL DISEASES BULLETIN.

PRESS OPINIONS.

"The application of scientific hygiene to health problems in the tropics is a movement which promises great things; and in the present volume we have an example of a work that is admirably adapted either as a text-book or manual for native or other physicians and students in warm countries."
—INTER-STATE MEDICAL JOURNAL.

"This is a handy yet comprehensive book, traversing practically the whole field of hygiene, well arranged, and with the information conveyed in plain language. It contains a very large amount of information, and should be most useful to all concerned with the practice of public health in India."
—JOURNAL OF ROYAL SANITARY INSTITUTE.

"An interesting and very profitable handbook. It must call forth praise and appreciation, for it is comprehensive, simple and practical. The many problems of the subject are briefly and yet sufficiently dwelt upon to serve as a guide in their solution. The book is one which can be useful to people who are not versed in the subject, but who have to meet practical solutions in everyday hygiene. Its language is simple, clear and interesting."
—DIETETIC AND HYGIENIC GAZETTE.

"This is an excellent little volume and is specially written from the point of view of tropical conditions, and as such is strongly to be commended. We can strongly recommend this volume as an admirable text-book for students and practitioners."
—INDIAN MEDICAL GAZETTE.

"We can recommend this as a useful work to all interested in public health questions, and specially to those whose practice lies in the tropical parts of Australia."
—THE AUSTRALASIAN MEDICAL GAZETTE, FEBRUARY 1913.

"There is room for a small manual of hygiene written in the form of a text-book which has special reference to Indian conditions, and we think Mr. Ghosh and Mr. Das have succeeded very well in their endeavour to supply this want. The authors have incorporated much valuable information from official Indian publications and from their own experience. The arrangement of subjects is orderly and methodical, and the work, considering its size, contains a large amount of necessary information on practical sanitation and theory of hygiene."
—THE LANCET, MAY 1913.

"The need for a handy text-book of Hygiene and Public Health in which a special reference is made to tropical conditions has been felt until the past few years, and the book under review contains such a large amount of useful information that it will take a welcome place among several recent works which deal with the problems of tropical hygiene. The book by Drs. Ghosh and Das possesses considerable merit. The large amount of valuable information which it contains, though this is presented in a very condensed form, should be clearly understood, more particularly by the medical readers."
—PUBLIC HEALTH.

"The book is a valuable contribution to the literature of a subject which is now engrossing the attention of the Government of India, and is specially noteworthy as the first important work on hygiene from the pen of Indian born and Indian educated medical practitioners."
—THE INDIAN AMBULANCE GAZETTE.

BUTTERWORTH & CO. (India), Ltd.

6, HASTINGS ST.

Post Box 251.

CALCUTTA.

